Master Thesis

Commercialization of Smallholder Farming: Determinants and Welfare Outcomes

A Cross-sectional study in Enderta District, Tigrai, Ethiopia

By

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The master thesis is carried out as a part of the education at the University of Agder and is therefore approved as such. However, this does not imply that the University answers for the methods that are used or the conclusions that are drawn.

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Abbreviations and Acronyms

ADLI	Agriculture Development Led Industrialization
ADB	Asian Development Bank
ANOVA	Analysis of Variance
BoFED	Bureau of Finance and Economic Development
CCI	Crop Commercialization Index
CSA	Central Statistics Agency
DECSI	Dedebit Credit and Savings Institutions
DFID	Department for International Development
DoC	Degree of Commercialization
E.C	Ethiopian Calendar
Ha	Hectares
IFPRI	International Food Policy Research Institute
KUSHET	Local name for a village in Tigrai
MFIs	Micro Financial Institutions
MoARD	Ministry of Agriculture and Rural Development
MoFA	Ministry of Foreign Affairs
MoFED	Ministry of Finance and Economic Development
OLS	Ordinary Least Squares
PASDEP	Plan for Accelerated and Sustainable Development to End Poverty
PRSP	Poverty Reduction Strategy Paper
SIDA	Swedish International Development Agency
TABIA	Local name for a sub-district in Ethiopia
USAID	United States Agency for International Development
WEREDA	Local name for a district in Ethiopia

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Goitom Abera

Declaration by candidate

I hereby declare that the thesis:

Commercialization of Smallholder Farming: Determinants and Welfare Outcomes (A Cross-sectional Study in Enderta District, Tigrai, Ethiopia)

has not been submitted to any other universities than the University of Agder for any type of academic degree.

Mekelle, Ethiopia, 24th May 2009

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Abstract

Transforming the subsistence-oriented production system into a market-oriented production system as a way to increasing the smallholder farmer's income and thus its welfare outcomes, and reducing rural poverty, has been in the policy spotlight of many developing countries, including Ethiopia, for some time now. However, there are no adequate studies in Tigrai focusing on the level of market integration of the smallholder farmers and whether the market participants are better-off in welfare outcomes. This study, thus, focused on identifying the micro-level factors determining market participation, the level of commercialization as well as evaluating the welfare outcomes of participant smallholders in Enderta District of Tigrai. Descriptive, statistical and econometric methods were employed to analyze the data collected from a sample of 125 households using structured household questionnaires. The findings from the statistical analysis showed that landholding size and land slope, irrigation use, number of oxen owned, and membership in extension package program have positive and significant association with commercialization while participation in non-farm activities has significant but negative association with commercialization. Nonetheless, descriptive findings showed that the degree of commercialization in the study area is very low (23%) even in comparison to the national average (33-36%), which is in itself considered to be low. The findings from the probit regression analysis revealed that production level (in value terms), use of improved seeds, use of irrigation and total landholding size are the most important factors affecting the ability of a smallholder to participate in output markets. Moreover, the findings from OLS estimation showed that the level of food and cash crop production (in value terms), gender, technology use (irrigation, improved seeds), use of fertilizer and the number of oxen owned per household are important factors determining the level of commercialization of smallholder farms. Finally, findings from one-way ANOVA analysis indicated that farm households with high degree of commercialization enjoyed better welfare outcomes (represented by consumption of basic non-grain consumables and expenditure on education, shoes and clothes, durables and housing). Therefore, the findings indicate that farmers with high level of commercialization are better-off in welfare outcomes. In addition, the findings indicate that farmers can be better integrated with the market if better support services are provided and efforts to enhance farmers' access to technology and assets are strengthened.

Key words: Smallholder, Commercialization, Welfare, Subsistence farming, Probit model, OLS estimation, Enderta- Tigrai

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

The Millennium Development Project's Hunger Task Force concluded in 2005 that "the world could meet the MDG of halving hunger by 2015", and that "development of agriculture is critical to that goal" (World Bank, 2007). Rural areas are the home of the majority in Africa and small scale agriculture is the mainstay of the rural economy serving mainly as a source of food income (Govereh et al., 1999). The literature shows that "with the adoption of improved technologies and modern techniques, access to agricultural inputs and investment in infrastructure, rapid growth in agricultural incomes is achievable in Africa" (Howard *et al.,* 1999; Palmer, 2004 cited in World Bank, 2007). Smallholder agriculture, which is the predominant source of livelihoods in Africa, has proven to be as at least as efficient as larger farms when farmers have received similar support services and inputs (seed, fertilizer, and credit) (IFPRI, 2002b cited in World Bank, 2007).

Many countries and international development agencies give due concern to intensification and commercialization of smallholder agriculture as a means of achieving poverty reduction; and thus they have reflected it in their official policies (Leavy and Poulton, 2007:2).

In Ethiopia, there were many attempts to integrate the farmers into the market since the 1950s. In the 1950s the emphasis had been on improving productivity and reducing economic dependence on agriculture whereas in the 1960s, it shifted to agro-industrial economy and increment of foreign earnings (Sharp et al., 2007:49). In the 1970's the focus shifted to smallholder potential after inefficiencies were observed in mechanized farms. In the 1980's the country adopted the socialist agricultural development strategy following the rise of the Derg regime to power. Since the coming to power of the current government in the 1990s, strong focus has been given to smallholder farming and poverty reduction, and supporting agricultural intensification (Sharp et al., 2007:49).

According to MoFED, the Ethiopian government has prioritized commercialization of farming as a policy agenda since 2005 and this priority is demonstrated by the central place this issue has gained in the second Poverty Reduction Strategy Paper (PRSP) (Sharp et al.,

2007:44). The second Poverty Reduction Strategy Paper for Ethiopia (PRSP), known as the Plan for Accelerated and Sustainable Development to End Poverty (PASDEP), is established up on eight pillars; the second pillar intends to achieve growth and thereby improve people's livelihoods and reduce poverty (MoFED, 2006 cited in Samuel and Sharp, 2007). The plan has set out two directions in order to achieve the aforementioned objectives: "commercialization of agriculture, based on supporting the intensification of marketable farm products (both for domestic and export markets, and by both small and large farmers); and promoting much more rapid non-farm private sector growth" (MoFED, 2006 cited in Samuel and Sharp, 2007:58).

According to Sharp et al. (2007:45), the Ethiopian government has shown commitment to re-orient smallholder farmers from subsistence to market focused production while also strengthening the development of large-scale and export oriented farming ventures to seize the benefits of large-scale production systems. There are approximately 11.5 million smallholders in Ethiopia (MoFED, 2006:45 cited in Sharp et al., 2007).

The Ministry of Agriculture and Rural Development (MoARD) has, under its 2004 master plan for enhanced market-oriented production, identified several crops, viz. teff, wheat, barley, lentil, chickpea, haricot beans, cotton, sesame, coffee and spices as priority crops (MoARD, 2004 cited in Samuel and Sharp, 2007:62). Accordingly, "the rural development strategy intends to contribute to the transformation of the productive rural sector from a primarily subsistence oriented to a more market-oriented sector, contributing to overall economic growth and poverty reduction" (Sharp et al., 2007:50).

According to Samuel and Sharp (2007:67), the final intention of going commercial is not just making a shift from subsistence to market oriented farming but, by doing so, to achieve better welfare outcomes for the smallholders. To the minimum, welfare can be represented by increased consumption of basic and high valued food (livestock products), higher expenditure on education, healthcare, shoes and clothes and durable goods.

1.2 Prior Researches

According to Gebremeskel et al. (1998 cited in Samuel and Sharp, 2007), only 28% of the total national grain production (cereals, pulses and oilseeds) was marketed in 1996. However, a study by the Ethiopian Economic Association (EEA) in 2004 indicates that grain output sales has grown to 33% for farmers who took part in the extension program and 36% for non-participants (Samuel and Sharp, 2007:65). The above data reflects only the gross amount sold at the end of the cropping season and it does not consider any quantities of grain that farmers might have bought during the same period.

A study by Mahelet (2007), based on the data collected from North Omo Zone, Southern Nations Nationalities and People's region (SNNP), indicates that land size and number of labor employed are crucial factors determining agricultural sales in the zone. In addition, the study found that other factors such as education, technology (such as irrigation) and shifting of production to high value crops could help a lot in improving the income and reducing poverty of smallholder farmers.

The findings from a nationally representative survey of 7, 186 farm households in Ethiopia, focusing on production and marketing decision of two cereal crops (teff and maize), indicates that most producers of the crops are either subsistence-oriented or net buyers; and that these group of producers are found to be poorer in many respects than net sellers (Pender and Dawit, 2007). According to Pender and Dawit (2007), increasing production of Teff and Maize is a major factor contributing to higher sales. Besides, factors such as increased access to roads, land, livestock, farm equipment, and traders are determinant to the enhancement of production and commercialization of these crops.

According to a study by Samuel and Sharp (2007), smallholders with high degree of market engagements have better potential of enjoying better standards of welfare. Similarly, Sharp et al. (2007) noted that enhancing the degree of commercialization of the smallholders can have more impact on reducing poverty than promotion of few large ventures.

In a study aiming at the analysis of the impact of institutional factors on the agricultural sales of individual farmers in Romania, Balint (2004), found out that small farm size, high

transaction costs in the input and output markets, lack of farming assets, and lack of cooperation among farmers were contributing factors to the low agricultural sales in Romania. In line with this, a study of the impact of policies and institutions in the commercialization of subsistence farms in transition countries, Lerman (2004) suggests that government should play an active role in the provision of basic services such as extension and education if the commercialization effort is to be a success.

Therefore, these researches indicate that commercialization of smallholder farms has the potential to enhance incomes and welfare outcomes, and take smallholder farmers out of poverty if constraining factors such as lack of capital, basic skills (farming and commercial), high transaction costs, lack of infrastructure, lack of information and lack of educations could be eliminated. In this case, government, in collaboration with NGOs and the private sector, could play an active role in facilitating and enhancing commercialization of smallholder farms.

1.3 Statement of the Problem

Govereh noted that "meeting the challenge of improving rural incomes in Africa will require some form of transformation out of the semi-subsistence, low income and low-productivity farming systems that currently characterize much of rural Africa" (1999:1).

Agriculture is the dominant sector in Ethiopia accounting for 85% of employment, more than 45% of the national income and 90% of the total foreign exchange earnings. Smallholder family farms cultivate approximate to 95% of the total cropped land and produce more than 90% of the total agricultural output (Mahelet, 2007).

It is in light of these realities that agriculture has become the hallmark of the development strategy of the country. The incumbent government has been pursuing the Agricultural Development Led Industrialization (ADLI) policy framework since 1994 (Sharp et al., 2007:50). ADLI combines various components supporting agricultural growth, including technology, finance, rural infrastructure, internal and external markets and the private sector focusing on (a) improving food security, (b) the commercialization of agriculture, (c) the extension of credit to small farmers and (d) industrialization (Sharp et al., 2007:50).

The rural development strategy, which emanates from ADLI, intends to contribute to the transformation of the productive rural sector from a primarily subsistence-oriented to a more market-oriented sector, contributing to overall economic growth and poverty reduction (Sharp et al., 2007:50). Building on the ADLI policy framework and Rural Development Strategy, PASDEP intends to achieve growth and thereby improve people's livelihoods and reduce poverty (Samuel and Sharp 2007:44). The two main avenues to achieve this are: "the commercialization of agriculture, and accelerating the development of the private sector, both within and outside agriculture" (Sharp et al., 2007:44).

However, the current reality shows that commercialization of smallholder farming is not yet high enough to enable farmers benefit from increased income and the farmers are not yet out of the subsistence-oriented agriculture (Mahelet, 2007:1). Market imperfections and high transaction costs have hindered smallholder farmers from exploiting the welfare outcomes of commercialization (de Janvry, Fafchamps, and Sadoulet 1991; Key, Sadoulet, and de Janvry 2000 cited in Bernard et al., 2007). Thus, it is not possible for the smallholder farmers to integrate with the market and enjoy the benefits of commercialization unless the already existing hurdles are removed and better environment is created (Bernard et al., 2007:1).

Therefore, it is imperative that research works, like this one, identify the factors determining the participation (or non-participation) of smallholder farmers in the output markets, analyze what factors affects the degree of commercialization of smallholder farms, and evaluate if market participants are better-off in terms of welfare outcomes. Such analysis "will help to design appropriate policy instruments, institutions and other interventions for sustainable economic development of small-holder farmers" (IFPRI and EDRI, 2006:2).

1.4 Objectives of the study

General Objective

The main objective of this study is to identify the demographic and socioeconomic factors determining market participation (non-participation) of smallholder farmers and to evaluate if there is vivid difference in welfare outcomes of smallholder farmers at differing levels of commercialization in the context of Enderta Wereda in Tigrai.

Specific Objectives

The following specific objectives are drawn on the basis of the general objective:

- to identify the demographic and socioeconomic factors determining market participation (non-participation) of smallholder farmers;
- to assess the current level of commercialization and to identify household and farm level characteristics which might explain variation in the level of commercialization among households; and
- to investigate the welfare situation of farmers operating at different levels of commercialization

1.5 Research Questions

This research project is going to answer the following research questions:

- What factors determine for a household to participate (or not) in output markets?
- What are the household and farm characteristics determining the degree of commercialization of smallholder farmers?
- Does the level of commercialization have an impact on the welfare of households?

1.6 Significance of the Study

According to Sharp et al. (2007:46), "the issue of commercialization has been addressed in a series of six regional consultations, held in 2006 and 2007, organized to develop and test an inclusive model of policy dialogue, and to generate indicative policy ideas and trends on the future of agriculture in Ethiopia." Hence, this study can be a valuable input in substantiating these efforts with empirical evidence from Tigrai.

This study can enrich the stock of existing but limited knowledge and literature whose focal point is commercialization of smallholder farms in Ethiopia and thus can serve as a reference material for policymakers, academicians and researchers.

Most importantly, this study can give a better insight in to the role of commercialization in enhancing welfare situation and reducing poverty of smallholder farmers.

1.7 Limitations of the study

As far as research is concerned, there would always be certain limitations. This study has also encountered certain challenges in the course of collecting data from the study areas. The first challenge was the difficulty of getting the randomly selected households on schedule in the course of collecting primary data from farm households. Second, several questionnaires had to be dropped either because of incomplete information or data recording errors on the part of enumerators.

1.8 Delimitations of the study

This study is bound to identifying demographic and socioeconomic factors determining the decision of smallholder farmers to participate (not participate) in output markets of crops; analyzing the welfare outcomes of smallholders at different levels of commercialization; and identifying the demographic and socioeconomic factors determining the decision of how much to sale in the output market. All these aspects will be dealt in the context of Enderta Wereda/District of Tigrai.

1.9 Organization of the thesis

This thesis paper is organized as follows: the second chapter is all about the presentation of relevant literatures and the theoretical framework in relation to commercialization of smallholder farming. Presentation of the research methodology including description of the study area is the subject of the third chapter. The fourth chapter is where the findings from the household survey questionnaire and key informant interviewees are presented and discussed both descriptively and using econometric tools. Finally, the fifth chapter incorporates the conclusions and policy implication of the results based on the major findings of the study.

CHAPTER TWO: REVIEW OF LITERATURE AND THEORETICAL FRAMEWORK OF THE THESIS

2.1 Introduction

Reviewing relevant literatures and defining the theoretical framework, on the basis of which analysis of empirical data from the field is made, are core activities of any researcher in the social sciences. The first section of this chapter, thus, presents review of related literature in line with the objectives and research questions stipulated in the first chapter. The second section of this chapter presents contextual background of the study area; namely, Ethiopia, Tigrai and the district of Enderta. Finally, the chapter presents the theoretical framework that the researcher has used in the analysis of the empirical data collected from four sub-districts of the study area.

2.2 Review of Related Literature

In this sub-section, the researcher presents general concepts about smallholder agriculture and its commercialization, and previous empirical findings on commercialization of smallholder farming, its contribution to household welfare and related issues.

2.2.1 The Role of Agriculture in Development

Agriculture has been playing significant role in the development of nations for centuries. The World Development Report 2008 states that agriculture can "produce faster growth, reduce poverty and sustain the environment" if it is made to work in concert with other sectors of the economy (World Bank, 2007:2). In fact, the report stipulates three ways through which agriculture contributes to development: 1) as an economic activity, 2) as a livelihood and 3) as a provider of environmental services (World Bank, 2007).

As an economic activity, agriculture helps the rural poor to achieve food security since majority of them derive their incomes from agricultural production. Specially, this contribution becomes vivid in the case of Sub-Saharan Africa where majority of the people

experience highly variable domestic production, limited tradability of food staples and foreign exchange constraints. As a source of livelihood, agriculture provides shelter to 86% of the rural poor. In fact, nearly half of the world population lives in rural areas and most of these depend on agriculture; smallholder households are about 1.5 billion. Interestingly, the decline in poverty rate of developing countries from 28% to 22% in 2002 is mainly attributed to falling poverty in rural areas; and 80% of the decline in rural areas is related exclusively to better conditions in rural areas. Despite the negative environmental outcomes-such as underground water depletion, soil exhaustion and agrochemical change, associated with agriculture, it is being recognized now that agriculture can positively affect the environment by sequestering carbon, managing watersheds and preserving biodiversity.

Given the realities that about half of the world's population lives in rural areas and most of these rural dwellers depend on agriculture for livelihoods, "agriculture is likely to be central to rural development and rural poverty alleviation" (Hazell et al., 2007:vii). Hazel et al (2007) further state that "farming has high potential to create jobs, to increase returns to the asset that the poor possess- labor and land, and to push down the price of food staples."

Many remain convinced that fast growth in agriculture plays a crucial role in the efforts of African countries to achieve the MDGs. In fact, the Millennium Development Project's Hunger Task Force concluded in 2005 that "the world could meet the MDG of halving hunger by 2015", and that "development of agriculture is critical to that goal" (World Bank, 2007). The role of smallholder agriculture in poverty reduction and economic growth is very significant in light of the current realities that 1.5 billion farm households live in rural areas of the developing world (World Bank, 2007).

The World Development Report 2008 states that the largest proportion of farmers in developing countries is smallholders and about 85% of them are farming in less than two hectares of land (World Bank, 2007). According to this report, in countries such as China, Egypt, Bangladesh and Malawi, smallholder farms with less than two hectares of farm land account for 95% of the total. Therefore, "the potential of agriculture to contribute to growth and poverty reduction depends on the productivity of small farms" (World Bank, 2007:90). In Africa, for instance, smallholder agriculture serves as the main engine of rural growth and livelihoods improvement given the limited resources available for rural industrialization (Govereh et al., 1999). The contribution of smallholder farms as the engine of rural growth

and livelihoods improvement depends on their level of transformation from subsistence oriented to market oriented production systems. In Tanzania, for example, most successful farmers who have managed to escape poverty were those who diversified their production to food crops and cash crops; in Uganda, going commercial and improving land productivity have become tools for escaping from poverty; and similarly, in Vietnam, the poverty rate of two-third of the small-scale farmers who got out of subsistence farming and took advantage of the market fell drastically as compared to those who remained in subsistence farming (World Bank, 2007:73).

Agriculture is the main and important sector in Ethiopia. About 85% of the population lives in rural areas where agriculture is the dominant economic activity and the largest sector in the economy contributing to about 50 percent to GDP and 90 percent to the export earnings (Samuel, 2004). Smallholder farmers in Ethiopia account for most of the Ethiopian population and the food grain production (Betre, 2006:2). Smallholder family farms cultivate approximate to 95% of the total cropped land and produce more than 90% of the total agricultural output in Ethiopia. It is in response to these facts that the Ethiopian government has prioritized commercialization of farms in general and smallholder agriculture in particular. In its second Poverty Reduction Strategy Plan, PASDEP, set for the time span 2005/06 to 2009/10, the government of Ethiopia:

> "Gives high consideration to commercialization of agriculture including a shift to higher-valued crops; promoting niche high-value export crops, a focus on selected high-potential areas, facilitating the commercialization of agriculture, supporting the development of large-scale commercial agriculture where it is feasible; and better integrating farmers with markets – both locally and globally" (MoFED, 2005 cited in Betre, 2006:2).

2.2.2 The Meaning of Small Farms/Smallholders and Agricultural Commercialization

The Meaning of Small Farms/Smallholders

There is no clear cut definition of small farms and smallholder farmers. In fact, Nagayets (2005:1 cited in Chamberlin, 2008:1) pointed out that "the sole consensus on small farms may be the

lack of a sole definition." The simplest and conventional meaning of a smallholder is the case when the land available for a farmer is very limited (Chamberlin, 2008:3 and Hazell et al., 2007:1). However, the meaning goes far beyond this conventional definition and consists of some general characteristics that the so called small farms or smallholders generally exhibit. Chamberlin has identified four themes on the basis of which smallholders can be differentiated from others. These themes include landholding size, wealth, market orientation, and level of vulnerability to risk (2008:3). Accordingly, the smallholder is the one with limited land availability, poor-resource endowments, subsistence-oriented and highly vulnerable to risk. Nevertheless, the smallholder may or may not exhibit all these dimensions of smallness simultaneously.

It is also common to set numeric value as a way to define small farms. Hazell et al. (2007:1), note that some literature define small farms as "those with less than two hectares of crop land" while others define smallholders as those endowed with 'limited resources,' such as land, capital, skills and labor. Similarly, there are also those authors who often describe small farms in terms of the low technology they mostly use, their heavy dependence on household labor and their subsistence orientation.

Context is also an important aspect when defining small farms (Hazell et al., 2007:1). Hazell et al. demonstrate this with a good example: whereas a 10-hectare land in several parts of Latin America would be less than the national average and mainly used for staple crop production, the same land size would be considered a medium or large holding for a Bengalese farmer who would hire labor and produce surplus for the market.

There is no clearly stated definition as to what constitutes a small farm in Ethiopia as it is the case in many developing countries too. However, it is well known that "small farmers in Ethiopia account for most of the Ethiopian population and the food grain production" (Betre, 2006:2). In Ethiopia, smallholder farmers cultivate about 95% of the total cropped land and produce more than 90% of the total agricultural output. The average land holding size of 1.18 hectares per farm household (CSA, 2007/08) in Ethiopia meets the conventional meaning of small farms (less than two hectares per household). Even far beyond that the smallholders in Ethiopia are known for their resource constraints such as capital, inputs and technology; their heavy dependence on household labor; their subsistence-orientation; and their exposure to risk such as reduced yields, crop failure and low prices (Betre, 2006; Mahelet, 2007).

In this study, the largest land holding size is found to be 3.5 hectares. All sample households in this study are treated as smallholders even though very few respondents exceeded the conventional two hectares ceiling for small farms. The main justification for this is that these households generally

fulfill the other dimensions of smallness; that is, limited access to resources such as capital, technology; ownership of fragmented land; high exposure to risk; and subsistence orientation.

Meaning of Agricultural Commercialization

Govereh et al. define agricultural commercialization as "the proportion of agricultural production that is marketed" (1999:5). According to these researchers, agricultural commercialization aims to bring about a shift from production for solely domestic consumption to production dominantly market-oriented. In line with the above definitions, Sokoni (2007:3) defined commercialization of smallholder production as "a process involving the transformation from production for household subsistence to production for the market." Hazell et al. (2007:4) found out that most definitions refer to agricultural commercialization as "the degree of participation in the output markets with the focus very much on cash incomes."

However, there are some writers who attach profit motive as an integral part of agricultural commercialization. Among others, Pingali and Rosengrant (1995:171 cited in Hazell et al. 2007) noted that agricultural commercialization goes beyond just selling in the output market. They claim that a household's marketing decisions, both in the output and input choice, should be based on profit maximization. According to Pingali and Rosengrant, commercialization does not only occur by the reorientation of agriculture to high valued cash crops but it could also occur by reorienting it to primary food crops (1995:171 cited in Hazell et al. 2007).

According to Von Braun et al. (1994:11), commercialization of subsistence agriculture takes many forms. They state that:

> "Commercialization can occur *on the output side* of production with increased marketed surplus, but it can also occur *on the input side* with increased use of purchased inputs. Commercialization is not restricted to just cash crops: The so called traditional food crops are frequently marketed to a considerable extent, and the so-called cash crops are retained, to a substantial extent, on the farm for home consumption, as, for instance, groundnuts in West Africa. Also, increased commercialization is not necessarily identical with expansion of the cash economy when there exist considerable inland transactions and payments with food commodities for land use or laborers. Finally, commercialization of agriculture is not identical with commercialization of the rural economy."

This thesis focuses on the degree of participation of farm households on the output market. But, as Von Braun et al. stated above, commercialization refers both to marketing of high value cash crops (such as pulse, oil and horticultural crops) as well as primary food crops (such as teff, wheat and barley).

2.2.3 Basic Concepts and Measures of Agricultural Commercialization

Modes of Agricultural Production

Leavy and Poulton (2007:22) found out that three different modes of agricultural production exist side by side and interact with each other. These are:

1. **Small-scale farmers**: these are further classified into two groups:
    - **Small-scale "non-commercial farmers"** (Type A) - these farmers are subsistence oriented but may also sell some of their production in the output market; but they can not wholly dependent on agriculture for living.
    - **Small-scale commercial farmers** (Type B) – these are better integrated with the market than the first group. In fact, they produce crops both for own consumption as well as for the market. They even exert effort to specialize on high value cash crops.
2. **Small-investor farmers**- these are exclusively engaged in market-oriented agriculture even though their size dictates their modest scale production. Samuel and Sharp (2007:59) refer to this people as being often educated and urban-based. They are known also as "emerging commercial farmers" (Samuel and Sharp, 2007).
3. **Large-scale business farming**- these refer to the capital intensive enterprises that are either private or state-owned (Samuel and Sharp, 2007).

These three categories indicate the different policy scenarios the government can possible adhere to in the course of assisting smallholder farmers to increase their income and mainly to come out of poverty.

Process of Commercialization

There are three levels of market orientation as far as food production systems are concerned, according to Pingali and Rosengrant (1995 cited in Leavy and Poulton 2007:9). These three levels are termed as subsistence systems, semi-commercial systems and commercial systems based on the farm households' objective for producing a certain crop, their source of inputs,

their product mix and their income sources. Table 2.1, adopted from Leavy and Poulton (2007:9), presents the three classifications with the respective characteristics of the households belonging to each category.

Table 2. 1: Level of market orientation with increasing commercialization

Level of Market Orientation	Farmer's Objective	Sources of inputs	Product mix	Household income sources
Subsistence systems	Food self-sufficiency	Household generated (non-traded)	Wide range	Predominantly agriculture
semi-commercial systems	Surplus generation	Mix of traded and non-traded inputs	Moderately specialized	Agricultural and non-agricultural
commercial systems	Profit maximization	Predominantly traded inputs	Highly specialized	Predominantly non-agricultural

Source: Pingali and Rosegrant (1995) but adopted from Leavy and Poulton (2007)

This way of categorizing the market orientation of farm households may not be applicable in many developing countries as simplistic as it is. However, it has much resemblance to the food production systems of smallholder dominated countries of Africa and South-east Asia. This categorization is quite appropriate for Ethiopia, as a predominantly agrarian country and smallholder dominated nation.

Measuring Agricultural Commercialization

According to Govereh et al. (1999:5), "commercialization can be measured along a continuum from zero (total subsistence-oriented production) to unity (100% production is sold)." Strasberg et al. (1999) suggested a measurement index called household Crop Commercialization Index (CCI) which is computed as the ratio of gross value of all crop sales over gross value of all crop production multiplied by hundred (cited in Govereh et al. 1999:4). The advantage of using this approach is that it "avoids the use of crude distinctions as commercialized and non-commercialized farms" (Govereh et al. 1999:5). However, this index is not without its limitations. For instance, consider the case when a farmer growing one quintal of teff sells that all and another farmer producing ten quintals of teff sells only two quintals. The CCI will tell us that the first farmer is fully commercialized (100%) while the second is semi-commercialized (20%). This interpretation does not make sense in such circumstances. Even though this limitation of using CCI is worth noting, there is still some room to use it in practice especially in the context of developing countries where it is less

likely to get smallholders selling all of their output and very large farms selling none of their output (Govereh et al. 1999).

As can be understood from the preceding discussion, the degree of participation in the output market is the conventional way to measure commercialization. However, Von Braun et al. (1994:11-12) provide other dimensions to the measurement of commercialization. Commercialization is calculated as percentage of the total produce sold from a household or as a percentage of cash crops as compared to all crops cultivated by a household (Von Braun et al, 1994). Von Braun et al (1994:11-12), have specified the forms of commercialization and integration into the cash economy from at least three different angles and measured the extent of their prevalence at the household level with the following ratios:

$$\text{(1a) Commercialization of agriculture (output side)} = \frac{\text{Value of agricultural sales in markets}}{\text{Agricultural production value}}$$

$$\text{(1b) Commercialization of agriculture (input side)} = \frac{\text{Value of inputs acquired from market}}{\text{Agricultural production value}}$$

$$\text{(2) Commercialization of rural economy} = \frac{\text{Value of goods and services acquired through market transactions}}{\text{Total Income}}$$

$$\text{(3) Degree of integration into the cash economy} = \frac{\text{Value of goods and services acquired by cash transactions}}{\text{Total income}}$$

2.2.4 Benefits of Agricultural Commercialization

The benefits of commercialization are multifaceted. Von Braun and Kennedy (1994) state that commercialization plays a significant role in increasing incomes and stimulating rural growth, through improving employment opportunities; increasing agricultural rural productivity; direct income benefit for employees and employers; expanding food supply and potentially improving nutritional status (cited in Leavy and Poulton, 2007:2). In most cases, these increased incomes have led to increased food consumption (Bouis 1994 cited in Pender and Dawit, 2007) and improved nutrition (Kennedy 1994 cited in Pender and Dawit, 2007).

Others look at the benefits of commercialization from the perspective of comparative advantage. According to Govereh et al. (1999), "commercialization increases productivity and income." The basic assumption embedded in the comparative advantage is that farmers produce mainly high value cash crops which provide them with high returns to land and labor and buy household consumption items using the cash they have earned from cash crop sales (Govereh et al., 1999). However, Govereh et al. (1999) warn that the previous assumption can not work if the market for non-cash crops is constrained by 'risks and high costs in the food marketing system.'

According to Timmer (1997), smallholder agricultural commercialization is significantly related with "higher productivity, greater specialization and higher incomes" (cited in Bernard et al., 2007). Timmer (1997) and Fafchamps (2005) further stated that the aforementioned outcomes give way to improvement in food security, poverty reduction and economy-wide growth (Bernard and Spielman, 2008:1).

Several researchers indicate that the outcomes of commercialization depend on whether efficient markets exist or not. If efficient markets do exist, then commercialization leads to separation of production from consumption, supporting food diversity and overall stability at household level (Bernard et al., 2007:1) and increased food security and improved allocative efficiency at macro level (Timmer 1997; Fafchamps 2005 cited in Bernard et al., 2007). But if markets remain inefficient and transaction costs are high, smallholders fail to exploit the blessings of commercialization.

Samuel and Sharp (2007:67) pointed out that agricultural commercialization is a bridge through which smallholder farmers are able to achieve welfare goals. They describe farm household welfare to represent consumption of basic food (grains), high value foods (livestock products), expenditure on clothes and shoes, durable goods, education and health care. They also note that greater engagement in output markets would result in higher agricultural productivity which is, in itself, an intermediate outcome rather than a welfare goal. Nonetheless, agricultural productivity can facilitate the achievement of the welfare goals of small farms.

2.2.5 Factors Influencing Potential Success of Commercialization of Smallholder Farming

Commercialization of smallholder farming can achieve its objectives and bring about the required benefits to the poor and rural based households when certain factors influencing its potential success or those that affect a farm household's decision to participate in the market are put in place. These influencing factors may be different for different contexts but empirical data refer to a host of factors common in the context of developing countries. Von Braun et al. (1994:13-14) point out that there are several exogenous factors that determine commercialization: population change, availability of new technologies, infrastructure and market creation, and macroeconomic and trade policy are considered to be among the most important driving forces.

Leavy and Poulton (2007:12) have identified three critical conditions that need to be in place if agricultural commercialization is to be a success for the smallholder. These are market access, access to staple foods and asset accumulation. Market access can be achieved in many ways. Many organizations including the DFID, USAID, ADB and SIDA (which advocate the market for the poor policy) believe that smallholder farmers can have better access to the market as a consequence of 'agricultural growth' and better infrastructural developments (Leavy and Poulton, 2007:12). Market for the poor initiatives also emphasize the need for better market information, strong farmer organizations and promotion of contract farming as a component of the effort to help farmers access the market.

The second critical condition for viability of agricultural commercialization that Leavy and Poulton (2007) have identified is access to food markets and food production. There are two contrasting views with regard to whether smallholders should focus on food crop or cash crop production. There are those who disagree with the claims of those who suggest that small farms should produce and sell high valued cash crops and buy food crops from the market with the income from the cash crops. They argue that such venture has high risk of food insecurity and price variations given the imperfections of rural food markets in Africa. Hence, smallholder priorities for subsistence farming are considered to be rational even if these farmers could have earned better incomes by diversifying into cash crop production. On the other side, there are those who argue that farm households producing cash crops to the market would mostly integrate food crops in their production system. Thus, they are less susceptible

to food insecurity; rather, they get higher yields in their food crop production than the purely subsistence based households (Von Braun and Kennedy 1994 cited in Leavy and Poulton, 2007).

The third critical factor in the pursuit of commercialization is asset accumulation, according to Leavy and Poulton (2007). Specifically, this refers to land and animal traction (livestock plus equipment). Land is obviously one critical factor that determines the chance of participation of a farm household in commercialization. In a study covering five African countries, Jayne et al. found that poor households are less responsive to market opportunities as a consequence of lack of land, capital and education (2003 cited in Leavy and Poulton 2007). Moreover, they found out that per capita income of households generally increases with increment in landholding size. Leavy and Poulton (2007) argue that farmers with small land holdings are forced to devote the largest portion of their land for food crop production given the poor food crop markets they are dependent in. Jayne et al. suggest that a strong system must be in place to provide technical advice; supply improved seeds and high value crops; supply fertilizer at an affordable rate to the poor; and create better linkages to a market for a high value crops if the effort to intensify and commercialize small sized farms is to be successful (2003 cited in Leavy and Poulton 2007). Another form of asset accumulation is animal traction. According to Leavy and Poulton (2007:21), accumulation of animal traction can benefit farmers in two ways: by increasing their responsiveness to rains and through provision of manure. Quick response to rains result in higher yields as it is the case with the use of manures which enhance soil fertility and thus yields of the farm household.

Pender and Dawit (2007) have developed a long list of factors that affect commercialization at local level based on the findings of different researchers (Pender, Ehui and Place, 2006). Accordingly, commercialization is affected by agro-climatic conditions and risks; access to market and infrastructure; community and household resources and endowments; development of local commodity, input and factor markets; laws and institutions; and cultural and social factors affecting consumption preference, production, and market opportunities and constraints.

From a different perspective but for the same issue, Mahelet (2007) assessed the literature and found out several factors that can either facilitate or constrain the commercialization of smallholder farming in the context of developing countries in general and Ethiopia in

particular. Accordingly, these factors include, among others, distance to the market, transport access and road access; availability of credit, extension services and market information; output, input and factor prices; land size, access to modern inputs and storage facilities; and integration into the output market.

2.3 Theoretical Framework

In order to answer the three specific research questions stipulated in chapter one, the researcher opted to follow the theoretical frame work discussed below.

The first research question of the study is "What factors determine for a household to participate (or not) in output markets?" The literature (see 2.2.5 and 2.2.6) shows that there are macro- and micro-level factors determining the decision or willingness of smallholder farmers to participate (or not) in the output market. In this study, however, the whole focus has been on identifying only micro-level factors determining market participation of farm households. The dependent variable is then market participation. Market participation can be represented by the letter Y and the regression equation representing market participation (the dependent variable, Y) and the independent variables (given in Table 2.2 below) is given by:

$$\begin{aligned} Y &= \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + ... + \beta_k x_{ki} + u_i \\ &= X\beta + U \end{aligned}$$

Where: Y represents market participation

X represents the factors that determine market participation

ßo and ß$_{1\text{-}k}$ are estimable parameters

U is the error term

The researcher opted to use the probit regression model to identify the factors that determine the decision of smallholders to participate in the output market. The fact that the dependent variable is a dichotomous one justifies the use of probit model. Accordingly, the dependent variable assumes only two values: 1 if the household participates in output market and 0 if it doe not. Accordingly,

Y = [1 if a household participates in the market, and

Y = [0 if otherwise]

The probit model is given by:

$$P(Y=1/X)=F(XB)=\frac{1}{\sqrt{2\Pi}}\int_{-\infty}^{XB} e^{\frac{-(XB)^2}{2}}dx$$

Where:

$$X=(1,\ x_{1i},x_{2i},...,x_{ki})$$
$$\beta'=(\beta_0,\beta_1,.....\beta_k)$$

The following are a host of the explanatory variables that are potentially expected to explain the variation in the dependent variable, market participation.

Table 2. 2: Specification of Explanatory variables for Probit Estimation

Variable	Specification	Expected sign
Sex	1 if male and 0 if female	+
Age	Age at time of interview in years	-
Apply Irrigation	1 if applies irrigation 0 if doesn't apply irrigation	+
Use Credit	1 if took credit 0 if did not take credit	+
Household labor size (Man Equivalent) [1]	Number of labor force who participated in farming (adult/men equivalent)	+
Oxen	Number of oxen owned	+
Participation in Non-farm activies	1 if participated 0 if not participated	-
Literacy	1 if literate and 0 if illiterate	+
Total value of crops produced	The Birr value of total crops sold in the last year.	+
Total land size (in Tsimdi)	Total land size cultivated in the year including rented-in land	+
Use Improved Seeds	1 if used fertilizer 0 if not used fertilizer	+
Total Income from livestock sales	Total birr collected from livestock sales in the year	-
Total income from non-farm self-employment	Total income earned from non-farm self-employment in the year	-
Total income from off-farm employment	Total income earned from non-farm employment in the year	-

Source: Survey 2009

[1] See Appendix G for the conversion factors used in calculating man-equivalent labor units

The second research question is: "What are the household and farm characteristics determining the level of commercialization of smallholder farmers?" This question deals with the level/degree of participation in the output market for those smallholders who have already participated in the output market. It attempts to identify why some farmers sell more and others less (in value terms). The level of gross value of crops sold is determined by a host of household level demographic and socioeconomic factors. The multivariate linear regression analysis/Ordinary Least Square estimation (OLS) is used to capture the cause and effect relationship between the dependent variable **total/gross value of all crops sold** and the independent variables that are specified in table 2.3.

Hence, the OLS regression estimator or the functional relationship between the dependent and independent variables is given by:

$$Y = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + ... + \beta_k x_{ki} + u_i$$
$$= X\beta + U$$

Where: Y represents the total value of all crops sold

X represents the factors that affect the level of total crop sales

ßo and ß1-k are estimable parameters

U is the error term

Table 2. 3: Specification of Explanatory variables for OLS Estimation

Variable	Specification	Expected sign
Sex	1 if male and 0 if female	+
Age	Age at time of interview in years	-
Education	Number of years of schooling	+
Total land size (in Tsimdi)	Total land size cultivated in the year including rented-in land	+
Total value of food crops produced	The Birr value of total food crops sold in the year.	+
Total value of cash crops produced	The Birr value of total cash crops sold in the year.	+
Use Improved Seeds	1 if used fertilizer 0 if not used fertilizer	+
Apply Irrigation	1 if used fertilizer 0 if not used fertilizer	+
Household labor size (Man Equivalent)	Number of labor force who participated in farming (in terms of adult/men equivalent)	+
Oxen	Number of oxen owned	+
Member of Extension Package	1 if member 0 if not member	+
Non-farm participant	1 if participated 0 if not participated	-
Livestock sales in birr	Total birr collected from livestock sales in the year	-
Use Fertilizer	1 if used fertilizer 0 if not used fertilizer	+
Transport Access	1 if has access 0 if does not have access	+
Gross non-farm income	Total income earned from non-farm activities	-

Source: Survey 2009

Finally, the third research question is: "Does the degree of commercialization have an impact on the welfare of households?" Commercialization is measured in many ways as the literature indicates (see 2.2.3). However, for the purpose of this study, it is calculated as the percentage of the total produce sold from a household as compared to all crops cultivated by a household (Von Braun et al, 1994). According to Von Braun et al (1994:11-12),

$$\textbf{Commercialization of agriculture (output side)} = \frac{\textbf{Value of agricultural sales in markets}}{\textbf{Agricultural production value}}$$

Samuel and Sharp emphasize on the issue that commercialization is not sufficient condition at its own right; it is, rather, "an intermediate outcome on the way to welfare goals" (2007:67).

Following Samuel and Sharp, smallholder's welfare is represented in terms of consumption of basic food (grains), high value foods (livestock products) and expenditures on cloths and shoes, durable goods, education, and healthcare. For the purpose of this study, a **one-way ANOVA (Analysis of Variance) test** is performed to compare welfare outcomes among households at varying degrees of commercialization.

CHAPTER THREE: MATERIALS AND RESEARCH METHODOLOGY

3.1 Description of the Research Area

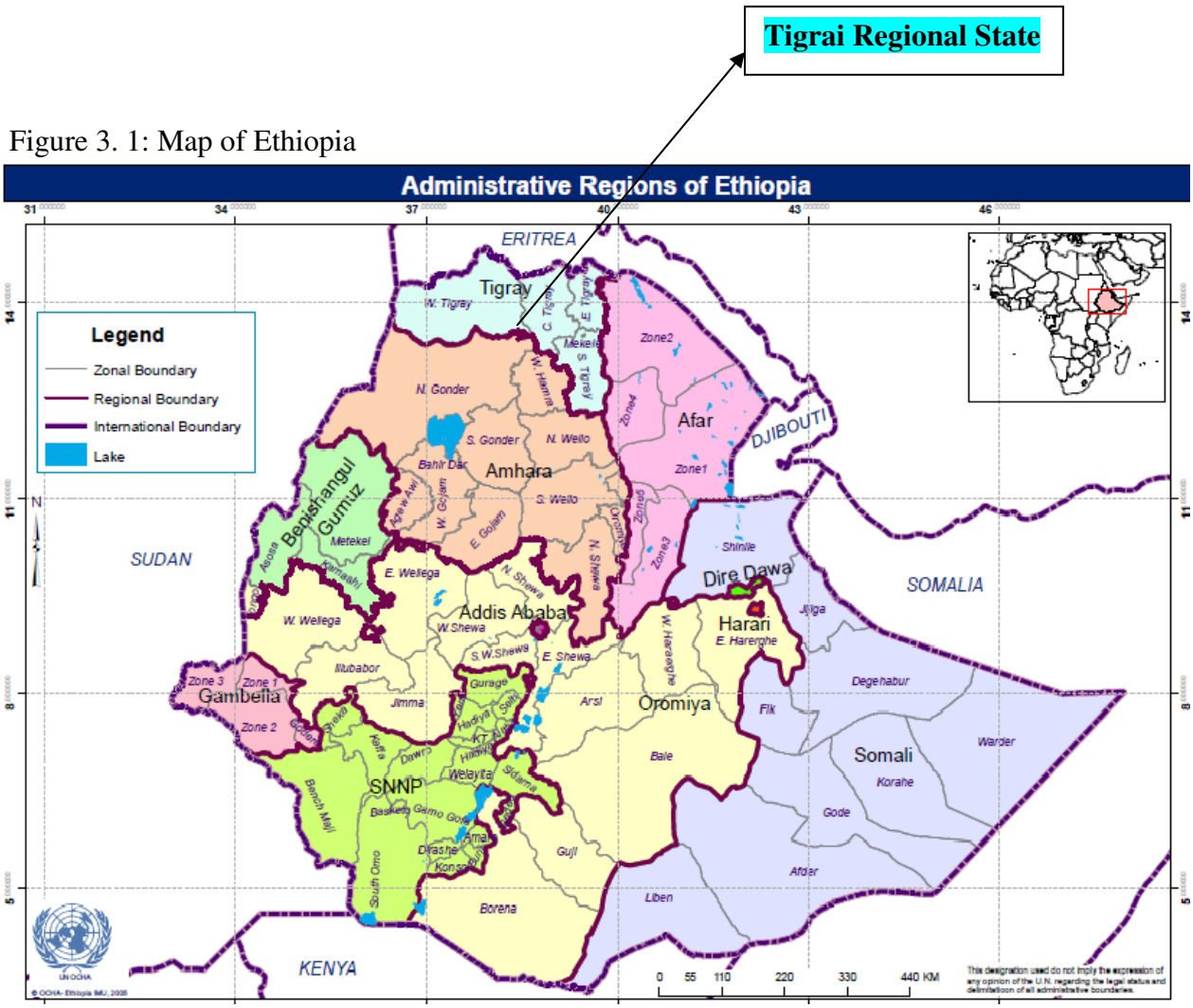
Ethiopia: The Ancient Nation

Ethiopia is one of the ancient countries in Africa known for its strong resistance to colonial rule and maintaining its independence; unlike most African countries, it has upheld its independence except for the brief Italian occupation from 1936 to 1941 (CIA The World Fact Book, 2008).

Facts from Ministry of Foreign Affairs (MoFA, 2008) indicate that Ethiopia is strategically located in the Horn of Africa, bordered by the Sudan on the west, Somalia and Djibouti on the East, Eritrea on the North and Kenya on the South. Its proximity to the Middle East and Europe, together with its easy access to the major ports of the region, enhances its international trade. The total area of the country covers an area of approximately 1.14 million square kilometers (944,000 square miles). Although Ethiopia lies within 15 degrees North of the Equator, owing to the moderating influence of high altitude, the country enjoys moderate temperature and pleasant climate, with average temperature rarely exceeding 20^{o}C (68^{o}F). The sparsely populated lowlands typically have sub–tropical and tropical climates. At approximately 850mm (34inches), the average annual rainfall for the whole country is considered to be moderate by global standards. In most of the high lands, rainfall occurs in two distinct seasons: the “small rains” during February and March and the “big rains” from June to September.

Ethiopia is the second populous country in Africa with 73.92 million people (CSA, 2008). Of the total population, 83.9% live in rural areas while the rest (16.1%) live in urban areas (CSA, 2008). Agriculture is the mainstay of the country and its contribution to GDP and employment accounts for 50% and 85% respectively (MoFA, 2008).

Figure 3. 1: Map of Ethiopia



Source: Bureau of Finance and Economic Development (BoFED), Tigrai, Ethiopia

Tigrai Regional State

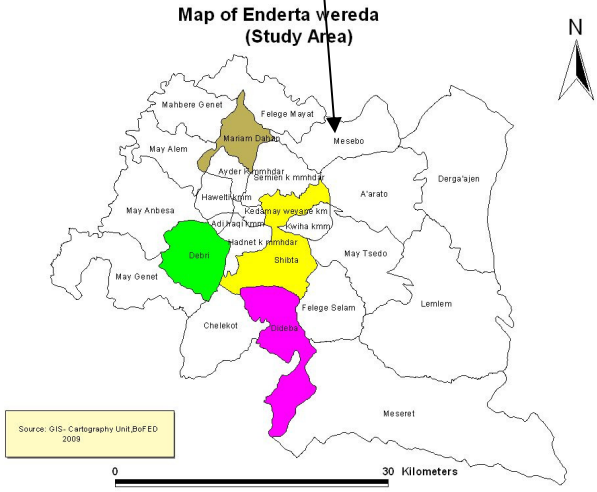
Tigrai is the Northernmost of Ethiopia's federal states located at 12°15` - 4°57` longitude and 36°27` - 39°59` latitude. The State of Tigrai shares common borders with Eritrea in the north, the State of Afar in the east, the State of Amhara in the south, and the Republic of the Sudan in the west. Excluding Mekelle town, the state capital, there are seven administrative zones: comprising a total of 47 Weredas and 673 Tabias (Tigrai Online, 2008). It covers an approximate area of 80, 000 square km, with a population of slightly more than 4.3 million, 80.5% of which live in the rural areas (MoFA, 2008; CSA, 2008). According to Gebremedhin and Swinton (2001:4), the region lies on a mountainous plateau with a tropical semi-arid climate characterized by erratic and unreliable rainfall.

Tigrai has three climatic zones: namely (Dega) temperate climatic zone constituting (11.5%) of the total land (wayna Dega) warm mild climate 40.5% and (Kola) hot low land climate zone (48%). Annual average rainfall ranges from 650 to 980mm (Addis Millenium, 2007). Agriculture is the mainstay of the economy of Tigrai. More than 80% of the regional population depends on mixed crop-livestock subsistence agriculture, with oxen power supplying the only draft power for plowing.

Figure 3.2: Map of the Regional State of Tigrai

Source: BoFED, Tigrai, Ethiopia

Figure 3.3: Map of Enderta Wereda/District



<u>NB</u>: the four colored areas in fig. 1.3 refer to the four sampled sub-districts of the study area.

Enderta Wereda

Enderta Wereda is one of the 47 districts of Tigrai. It is one of the four districts in the Southeastern administrative zone of Tigrai. It is located at a 13^{o}:15`:00`` N and $39^{o}$:30`:30`` E with an altitude ranging from 1500 to 2000 meters above sea level. It shares borders with Kilte`awlaelo district in the north, Hintalo Wajirat in the south, Afar regional state in the east and the district of Degu'a Tembien in the west. The Wereda covers a total area of 89,812 square kilometers of which 30,062 hectares is cultivable land. The total population size is 114,277 according to the 2007 population census of the CSA (2008). It constitutes 17 sub-districts and 67 villages. The capital city of the region, Mekelle, is encircled within Enderta making it more advantageous to the district from market proximity point of view.

The agro-climatic state of the Wereda is mainly (96%) warm mild climate, with remaining 3% and 1% hot low land climate and temperate climate respectively. Annual average rainfall ranges from 450 to 550mm. In concurrence to the agro-climatic state of the Wereda, smallholder mixed farming remains the single largest tributary to the livelihoods of the population. Major crops grown in the Wereda include teff, wheat, barley, sorghum, millet, oil seeds, pulse seeds, horticultural crops and vegetables.

3.2 Research Strategy

In this study, both quantitative and qualitative research strategies were employed. The quantitative strategy was used to analyze the data that was collected using structured household survey questionnaire from a representative sample of 125 household heads that were selected from four sub-districts of Enderta in South-eastern zone of Tigrai. The qualitative research strategy was used to analyze data that was collected using the un-structured interviews with key informants: agricultural and rural experts from two-sub districts of the Enderta Wereda. This interview with the key informants was conducted to

supplement some information that were not captured by the questionnaire and to crosscheck the consistency of the responses from the household survey.

3.3 Research Design, Method and Data collection

The research design that was used in this study is the cross-sectional (or survey) design. Accordingly, data relating to the commercialization of food and cash crops (cereal crops, pulses, oil crops and horticultural crops) for the production and harvest year of June 2007 to April 2008 was collected and analyzed.

Both primary and secondary data were collected. Structured household survey questionnaire were used to collect primary data on the demographic and socioeconomic characteristics of smallholders from a representative random sample of household heads in four purposively selected sub-districts of Enderta. In addition, unstructured interviews were conducted with key informants at sub-district levels. Furthermore, secondary sources such as documents, journal articles and related materials were used to back up the findings from primary sources.

3.4 Sampling Frame and Sample Size

There are 17 Tabias and 67 Kushets in Enderta district. The total household-head population size of the district is 28,518 of which 19,832 are male-headed and the 8, 686 are female headed households.

The researcher followed a two-stage process to select the sample respondents for this study. First, the researcher selected four sub-districts purposively on the basis of better market integration of the sub-districts. Accordingly, Debri, Didiba, Mariam Dihan and Shibta were selected as the sample sub-districts. Next, a list of all household heads was acquired from the respective agricultural and rural development offices of the respective sub-districts; and then the researcher selected 140 household-head respondents in total from the four sample sub-districts using the systematic random sampling method. The following table summarizes the population size, sample size and actual number of respondents for each sub-district.

Table 3. 1: Sample frame and Sample size

S.N	Name of Tabia/Sub-district	Total household population size	Sample size and no. of questionnaires distibuted	No. of questionnaires collected
1	Debri	1508	35	34
2	Didiba	1614	40	37
3	Mariam-dihan	1356	35	28
4	Shibta	2307	30	26
	Total	**6785**	**140**	**125**

Source: Own survey 2009 & agriculture and rural development office of Enderta District

Even though 140 questionnaires were distributed, only 125 were used for the study; the remaining fifteen questionnaires were discarded because they were either incomplete or inconsistently filled. However, the response rate (89%) is much higher than the minimum requirement that most research books have set.

3.5 Data Analysis

Descriptive, statistical and econometric methods were used to analyze the primary data collected from smallholder household heads using structured questionnaire. Descriptive methods such as measures of averages and percentages; and statistical methods such as one-way ANOVA tests and two-sample t-test were used to describe and analyze the household-level characteristics including the state of resource ownership, production, marketing, social capital, non-farm activities and demographics of the sample households. Statistical analysis helped mainly to answer the third research question. The probit regression analysis was used to answer the first research question. Multivariate linear regression analysis was also used to identify factors determining the level of commercialization of smallholder farmers and gave answer to the second research question. STATA software package was used to run the probit regression and multivariate linear regression models, and to analyze the quantitative data.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 An Overview of the Chapter

It is to be recalled from the previous chapter that quantitative as well as qualitative data was collected from structured questionnaires and key informant groups in the selected *Tabias* of the Enderta *Wereda*. In this chapter, the results of the findings from these two sources are discussed thoroughly followed by the discussion of the respective issues of interest. First, descriptive and statistical analyses of the demographic and socioeconomic characteristics of the sample households are presented. Next, econometric (empirical) analyses of the market participation of smallholder farming households are presented.

4.2 Commercialization of Smallholder Farming: Descriptive and Statistical Analyses I

4.2.1 Demographic and Socioeconomic Characteristics of Household Heads

This sub-section presents the demographic and socioeconomic features of the 125 sample respondents. These features are found to be of great help in terms of clearly depicting the diverse background of the respondents and the impact this diversity has had on the descriptive, statistical as well as econometric results.

Table 4. 1: Demographic and socioeconomic background of household heads

Household Attributes	N	Mean	Std. Deviation	Min	Max
Sex (1=male, 0=female)	125	.784	.41	0	1
Age (in years)	125	44.78	10.97	20	69
Education (no. of years of schooling)	125	2.02	2.38	0	8
Education (1=literate, 0=illiterate)	125	.544	.50	0	1
Land Ownership (1=Yes, 0=No)	125	1	0	0	1
Land holding size per capita	125	1.14	.48	.25	3.5
Got Land Use Title Certificate (1=Yes, 0=No)	125	.936	.25	0	1
Land market participation (1=Yes, 0=No)	125	.424	.49	0	1
Number of Oxen owned	125	1.61	1.19	0	7

Source: Survey 2009

The statistical summary provided in Table 4.1 shows that the proportion of male-headed households (78.4%) is quite higher than that of female-headed households (21.6%). This figure is in line with the Tigrai Region's statistical facts. The mean age of a typical household head is about 45 years with the youngest being 20 and the oldest 69 years old. On average, a typical household head attended about two years of formal education whereas the range goes from those who did not attended formal education at all to those who attended eight years of schooling. Categorically, 54.4% are literate whereas the 44.6% are illiterate indicating that most of the household heads can, at least, read and write- an important factor in the commercialization of farming. The fact that 100% of the respondents own land is not as such surprising given the long history of transfer of land from parents to off-springs in Tigrai and other regions of Ethiopia. The per capita land holding size is slightly above one hectare(ha) even though there are those who own as small as .25 ha and those who own as large as 3.5 ha. The mean land holding size is a good indicator of the dominance of smallholder farmers in the Enderta district as it is the case in the region and the country at large. Around 94% of the respondents have already acquired land use title certification from the government; this certification is very important to the farmers in the sense that it enhances their feeling of security and sense of ownership given the legal provision that land belongs to the government in Ethiopia. In turn, such feeling of security and ownership encourages the farmers to invest in their land thereby enhancing land productivity and market participation. Land rental market is an important facet in the commercialization of agriculture in light of the impossibility of buying or selling land. However, only 42.4% of the total respondents took part in the land rental market (either rented-in or rented-out land). Finally, the table above depicts that a typical household head owns about 2 oxen, which shows the poor asset endowment of smallholders.

4.2.2 Land Ownership, Size and Quality

Land is one of the most important inputs for rural households whose primary means of livelihoods is farming. Land ownership, size and quality are important factors determining agricultural production and market participation of households. The following table summarizes the land endowment of the households constituting the sample for this paper.

Table 4. 2: Status of land ownership of household heads

Item	Response	Freq	Percent (%)
Own land(1=yes, 0=no)	Yes	125	100

Source: Survey 2009

As can be seen from Table 4.2, all the respondents own land. However, there is significant variation along landholding size and land quality (in terms of thickness, slope and soil texture).

Table 4. 3: Distribution of land holding size in Hectares

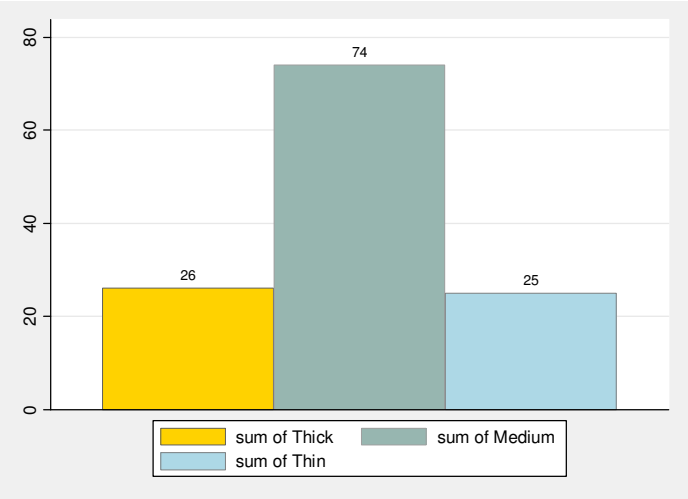
Land size in Hectares(Ha)	Freq.	Percent
0.5 and under	14	11.2
0.51 - 1.00	52	41.6
1.01 - 2.00	57	45.6
2.01 and over	2	1.6
Total	125	100.00

Source: Survey 2009

Table 4.3 shows that the majority of the households (86.2%) own between half and two hectares. The average landholding size is computed to be approximately 1.14 hectares and the minimum and maximum holding size per household is computed to be 0.25 and 3.5 hectares of land respectively (see table 4.1). The mean value is slightly above the 1.08 ha average holding size per household for Tigrai State and slightly lower than the national average of 1.18 ha given in the Agricultural Sample Survey for 2007/2008 (2000 E.C) by the Central Statistics Agency(CSA) of Ethiopia (CSA 2008). These figures demonstrate the fact that majority of the Ethiopian farmers are smallholders and the special attention they deserve to get from policy makers.

Land holding size is one of the major determinant factors for agricultural harvest and commercialization. One way ANOVA test revealed that there is a statistically significant difference among the four land holding size categories in terms of the mean level of total crop production value (Prob >F= 0.0000), total sales (Prob >F= 0.0031) and degree of commercialization, DoC, (Prob >F= 0.0620) (See Annex C, Table 1.1-1.3). However, land holding size is not yet a sufficient condition by itself. Quality of the land is a critical factor too. Land quality refers to thickness, slope and soil texture. The natural composition of these factors can either boost production and thus output sales or restrain such a capability.

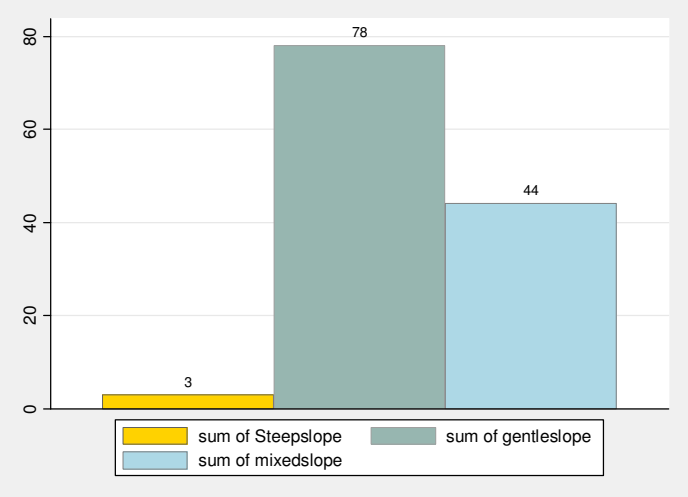
Figure 4. 1: Distribution of Land Thickness



Source: Survey 2009

The thicker the land, the higher is the agricultural productivity and the higher the likelihood of participation in the output market. According to figure 4.1, majority of the household heads (59%) own land characterized by medium thickness. The proportion of household heads endowed with thin and thick land character is given by 21% and 20% respectively. However, the results of one way ANOVA test indicates that there is no significant association between land thickness and total crop production value, total crop sales value and DoC in the context of Enderta Wereda. This could be due to the fact that there is no significant variability in the nature of land thickness for the majority of the households.

Figure 4. 2: Distribution of Land Slope



Source: Survey 2009

Farmers cultivating in a gently sloping land enjoy higher production than those who cultivate in steeply sloping land. Unlike the common phenomenon of cultivating in steeply sloping hills in many parts of Tigrai State, farmers in the Enderta Wereda/District are lucky enough in the sense that the majority cultivate gently sloping land. Fig. 4.2 demonstrates that about 62.4% of the sample respondents from the four sub-districts own gently sloping land while only 2.4% cultivate crops in a steeply sloping land. The balance (35.2%) own and cultivate in an amalgamation of gentle and steep sloped land (mixed sloping). Interestingly, one way ANOVA test result disclosed that land slope is strongly associated with degree of commercialization (Prob > F= 0.0275). (See Annex C, Table 2.1)

4.2.3 Primary Economic Engagement (Occupation) of Household Heads

Ethiopia's economy is mainly dependent on agriculture. Agriculture employs about 85% of the population. This is also true with the Tigrai region of Ethiopia. In Tigrai, farmers account for 83% of the population (Tigrai Online, 2008). Mixed farming is the dominant form of smallholder agriculture in Ethiopia (Berhanu, 2004:142). This fact is also reflected in the survey results shown in the table below.

Table 4. 4: Primary Economic Engagement of Household Heads

Economic Engagement	Sex		Total
	Female	Male	
Crop production	10 37.04(%)	18 18.37(%)	28 22.40(%)
Mixed Farming	17 62.96(%)	80 81.63(%)	97 77.60(%)
Total	27 100.00(%)	98 100.00(%)	125 100.00(%)

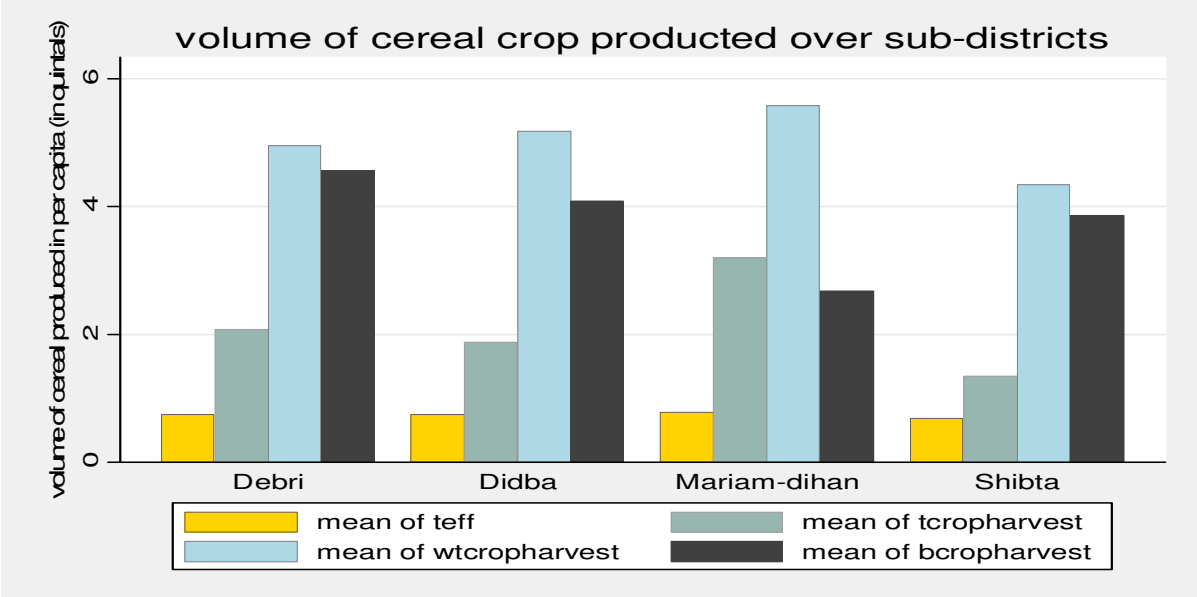
Source: Survey 2009

Table 4.4 depicts that majority of the sample respondents (77.6%) are engaged in mixed farming (crop production and animal rearing) while the rest of the respondents are engaged solely in crop production. Gender wise distribution also shows similar trend; about 63% of female household heads and 82% of male household heads are engaged in mixed farming.

Unstructured interviews with agricultural experts in the sampled sub-districts revealed that farmers in Enderta *Wereda* produce different types of grains but they are mainly engaged in the production of cereals (mainly wheat, barley and teff), pulse crops (mainly lentils), oil

crops (mainly linseed), horticultural crops (mainly potato, onion, tomato, carrot, Pepper and cabbage) and fruits (mainly guava).

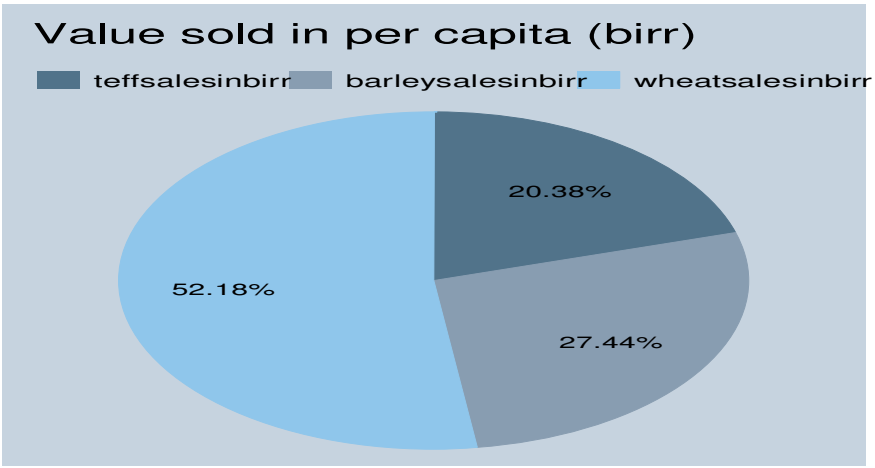
Figure 4. 3: Volume of Food Crop Production by the four Sub-districts 2007/08



Source: Survey 2009

The bar graph depicted as Figure 4.3 reveals that wheat had taken the lion's share of the total cereal crop production in the entire sample *Tabias* of the Enderta *Wereda* for the harvest year of 2000 E.C (2007/08). Barley assumed the second place in terms of volume of production while teff had taken the third place. In fact, this finding complies with the findings from the in-depth interview with agricultural experts of the sub-districts.

Figure 4. 4: Percentage of total sales for cereal crops

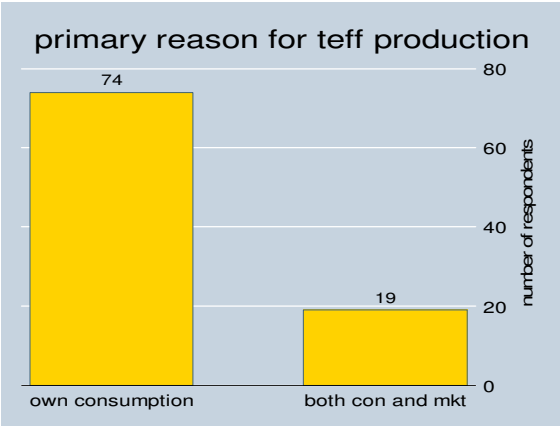


Source: Survey 2009

As can be seen from the pie chart depicted as Fig. 4.4, wheat sells (in birr) account for the largest percentage (52.18%) of the total sales volume earned by the typical household head followed by barley (27.44%) and teff (20.38%) respectively.

It is very important that we understand the primary motive of households to produce one type of crop or the other since the decision to participate in the market is partly determined by this motive. Consequently, the following bar graphs give a good insight on the issue. It is worth mentioning that non-producers are excluded since such data is not applicable in this regard.

Figure 4. 5: Primary reason for teff prodn

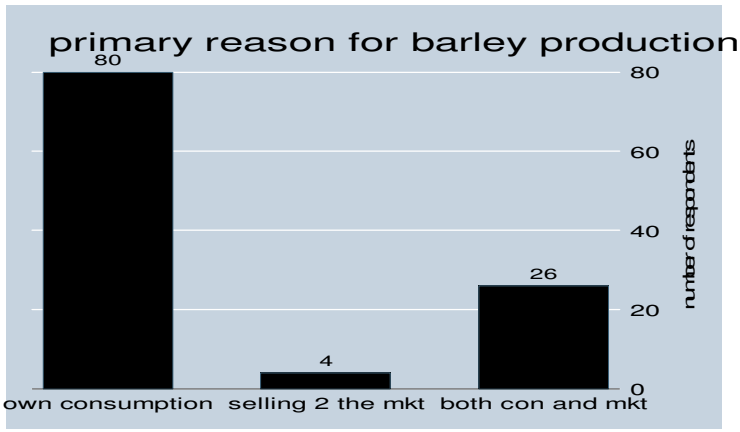


Source: Survey 2009

Figure 4. 6: Primary reason for wheat Prodn

Source: Survey 2009

Figure 4. 7: Primary reason for barley production



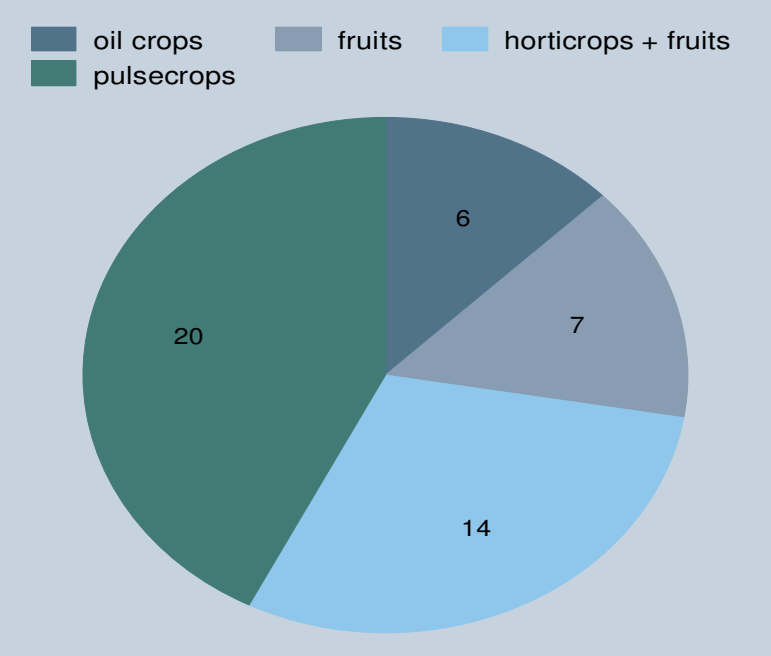
Source: Survey 2009

The three bar graphs designated above as figures 4.5, 4.6 and 4.7 represent the distribution of sample households by the prime reason for producing each of the three main cereal crops. Accordingly, the three graphs show us that majority of the household heads produce these three cereal crops with the prime intention of maximizing their own consumption. However, there are still some households who produce partially for own consumption and partially for

selling in the market. Only quite a few of the sample households produce cereals with the sole aim of selling to the market. This indicates that food self-sufficiency is still top priority of rural households, at least in the context of the four sub-districts of Enderta *Wereda*. Wheat is the main cereal that majority of the households produced with the sole aim of selling to the market. It was also the crop with the highest level of production in all the four sub-districts depicted in fig. 4.3. These results indicate that most smallholder farmers in the study area would mostly sell cereal crops when the volume of production goes beyond the subsistence level, other things remaining constant.

Besides producing cereals, many households were also engaged in the production of pulse, oil and horticultural crops. Still others were engaged in the production of fruits. The prime reason for producing these cash crops was solely for the market.

Figure 4. 8: Number of cash crop producers by type



Source: Survey 2009

Out of the total sample households involved in smallholder farming, only 47 (37.6%) were found to have engaged in cash crop production while the remaining 78 (62.4%) did not take part in the production of any of the cash crops outlined previously (Fig. 4.8). Most (n=20) of those who participated in cash crop production have primarily produced pulse crops (mainly

lentils). Some have produced a combination of both horticultural crops and fruits (14); while others produced fruits (7) (mainly guava) and oil crops (6) (mainly linseed).

Generally, the farmers in the four sub-districts fall into the first group of farmers (type A and B) that Leavy and Poulton (2007:22) have categorized as "non-commercial" and "commercial" farmers (discussed in chapter two) on the basis of the mode of production the farmers have followed. The bar graphs and pie chart (Figures 4.3-4.8) indicate that the majority belong to type-A farmers.

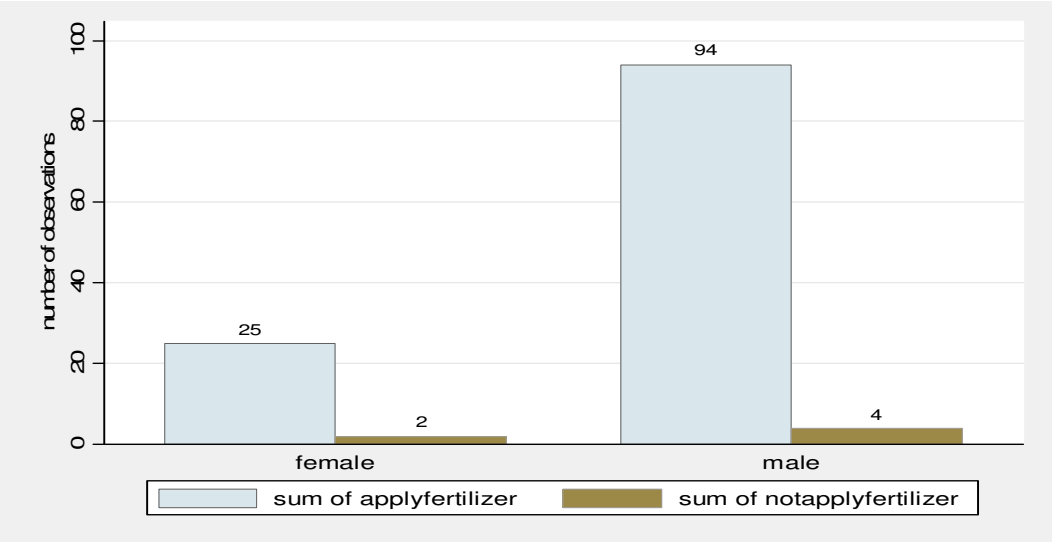
4.2.4 Farm Inputs and Technology Use

Soil fertility is one major determinant factor in agricultural productivity. However, different research outputs indicate that in Africa such productivity has been constrained partly by the low soil fertility (World Bank, 2007). According to the World Development Report 2008, the land with high agricultural potential in Africa accounts for 6% of the total. Hence, one way to improve soil fertility and thereby intensify production is the application of fertilizers. Use of improved seeds has also become very popular in the developing world since recent time, especially in countries, like Ethiopia, where land holding size and its productivity has been dwindling at a faster rate. The other tool that is believed to have a significant role in boosting the production and market participation of the smallholder farmer is the application of farm technologies such as irrigation.

Fertilizer Use

Fertilizer use is normally expected to boost production and the possibility of households to engage in output markets. Unfortunately, the **two-sample t test** result disapproved this expectation. Accordingly, there is no statistically significant association between mean crop production value, mean sales value and degree of commercialization on the one hand and fertilizer use on the other.

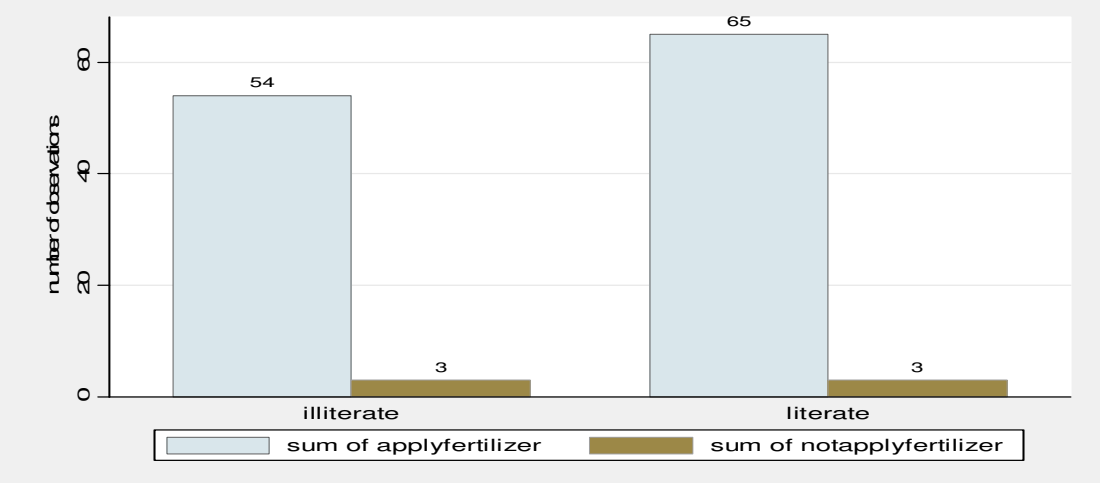
Figure 4. 9: Use of fertilizer by gender



Source: Survey 2009

Fig. 4.9 shows that about 95% (119) of the households in the survey have applied fertilizer in their farms as of the production year of 1999/2000 E.C (June. 2007 to April 2008). There is no statistically significant difference between male-headed and female-headed households as far as fertilizer application is concerned. It seems there is high degree of acceptance to use inorganic fertilizer on the part of smallholder farmers. The justification given by agricultural experts of the sub districts was that the farmers do not have other options given the low soil fertility of their land.

Figure 4. 10: Distribution of fertilizer use by educational status



Source: Survey 2009

It seemed interesting when Fig. 4.10 revealed some crude difference in fertilizer application across educational status. A literate household head seems to have more tendencies to apply fertilizer than an illiterate household head. Unfortunately, the **chi-square statistical test** did not support the hypothesis that there is statistically significant difference in fertilizer application between literates and illiterates.

DAP and UREA are the two mainly used chemical fertilizers through out the developing world even though farmers have also been using, mostly locally produced, organic fertilizers (for example, animal manure).

Table 4. 5: Number of respondents applying DAP and UREA

Urea used	DAP used		Total
	Yes	No	
Yes	**119** 100%	0 0.00%	**119** **95.2%**
No	0 0.00%	**6** 100%	**6** **4.80%**
Total	119 100%	6 100%	**125** **100%**

Source: Survey 2009

It is easily observable from table 4.5 that all those who applied fertilizers have purchased both DAP and UREA simultaneously. This fact has been cross-checked through an in-depth interview with the agricultural experts who have witnessed the practice of mixing these two fertilizers as a common phenomenon in the farming community.

Table 4. 6: Mean amount (in Kgs) of DAP and UREA applied per hectare

Quantity Applied	Obs	Mean	Std. Dev.	Min	Max
DAP qty applied/Ha	125	57.44606	40.62536	0	200
UREA qty applied/Ha	125	55.11616	37.63458	0	200

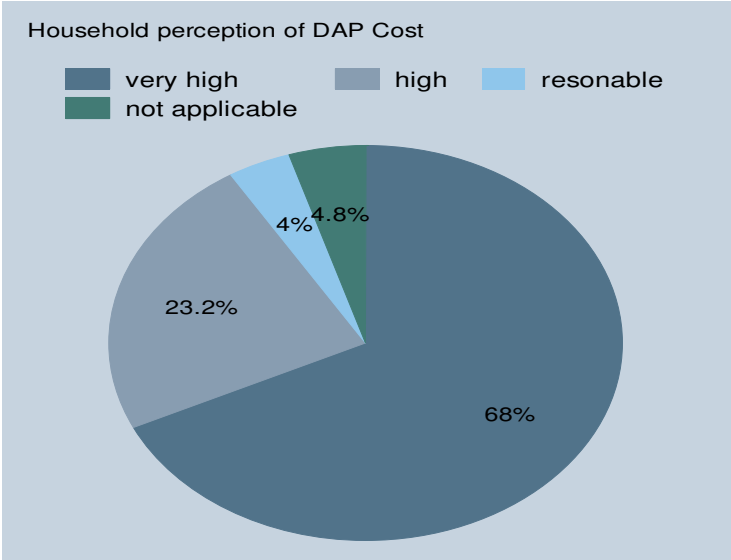
Source: Survey 2009

The statistical summary given in table 4.6 indicates that the mean amount of fertilizer applied per hectare is given by 57 Kgs and 55 Kgs for DAP and UREA respectively. However, there is a high degree of variation in the level of application among individual households as can be seen from the standard deviation values of 40.6 and 37.6 Kgs for DAP and UREA respectively.

Even though majority of the sampled households are consumers of chemical fertilizers, this does not mean that all are happy with cost of acquiring fertilizers. This paper had attempted to

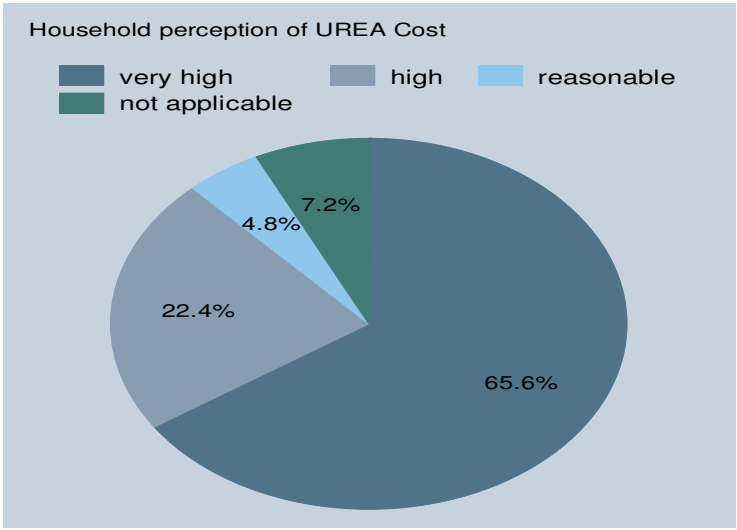
extract important information with regard to their perception of cost of acquiring fertilizers. The following bar graphs provide such information in a clear manner.

Figure 4. 11: Perception of households on cost of DAP



Source: Survey 2009

Figure 4. 12: Perception of households on cost of UREA



Source: Survey 2009

On the basis of the above pie charts (Fig. 4.11 and Fig. 4.12), it can be observed clearly that the overwhelming majority of the farmers believe that the price at which they purchase the fertilizers is high or very high (about 91% for DAP and 88% for UREA). Only a small minority of them consider the price to be reasonable (about 4% for DAP and 4.8% for

UREA). Of course, the price of fertilizer has been steadily increasing over the last several years due to a general price increment at the international market. Hence, the matter goes beyond being perception only; it is something tangible since prices have been high as a consequence of the price hikes at the global market. The smallholder farmers have no option but to bear the burden of increasing prices since subsidy programs have long been eliminated following the structural adjustment programs (SAPs).

Use of Improved Seeds

Use of improved seeds has gained momentum as the application of such seeds would enhance agricultural productivity and the chance of participating in the output markets. The World Development Report 2008 has indicated that growth in agricultural productivity has been fast in places where 'modern seed varieties and fertilizers' is adopted and remained sluggish if otherwise (World Bank, 2007:150).

For the study area at hand, the majority of the households (56.8%) bought and used improved seed while a sizable number of households (43.2%) did not buy any (see Table 4.7). Among those who bought and applied improved seeds, the majority (n=69) bought improved variety of wheat while only few have bought improved variety of teff (n=2).

Table 4. 7: Application of Improved Seeds by Type of Seed

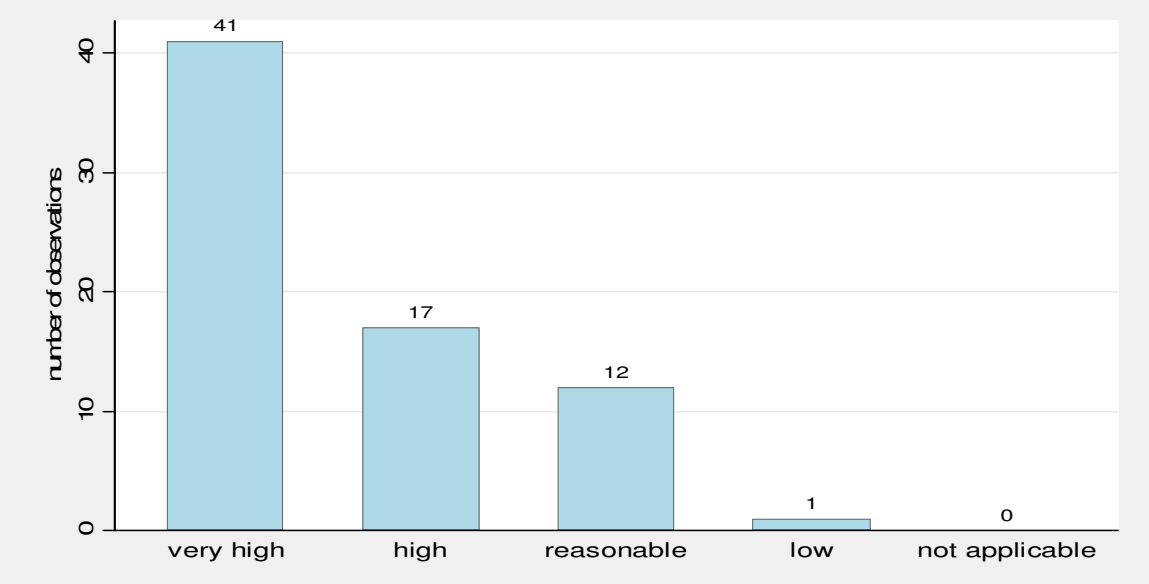
Applied Improved Seed	Type of Improved Seed			Total
	Wheat	Teff	None	
Yes	69 100%	2 100%	0 0.00%	71 56.8%
No	0 0.00%	0 0.00%	54 100%	54 43.2%
Total	69 100%	2 100%	54 100%	125 100%

Source: Survey 2009

Econometric analysis provided in the forthcoming section (see Table 4.13 and 4.15) revealed that use of improved seeds has statistically significant relationship with total crop sales and market participation. Hence, it is worth asking why quite large number of the respondents did not purchase improved seeds when it could have possibly enhanced their agricultural

productivity and thereby their total sales and market participation. One possible explanation could be the high cost of acquiring these improved seeds.

Figure 4. 13: Household head's perception of the cost of acquiring improved seeds



Source: Survey 2009

As fig.4.13 reveals, majority of those who used improved seeds (n=58) feel that the cost of acquiring improved seeds is high or quite high; only few of them (n=13) consider it to be reasonable or cheap. Therefore, the cost of acquiring improved seeds could be one logical reason hindering many from participating in the improved seeds market.

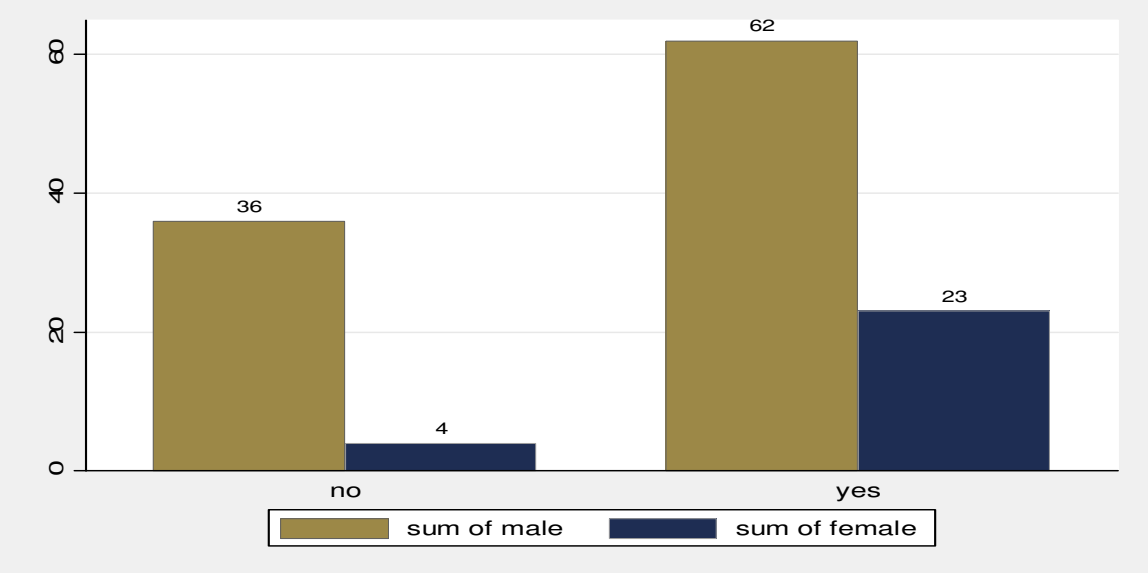
Access and Use of Credit

According to the in-depth interview conducted with agricultural experts in the study areas, there are two important ways through which farmers acquire credit. One is through a microfinance institution operating throughout Tigrai, Dedebit Credit and Savings Institution (DECSI). This institution provides variety of financial services in rural and urban Tigrai with the primary focus on the rural poor. Micro Finance Institutions often target rural areas, where social capital is stronger (World Bank, 2008:144). In Tigrai, smallholder farmers get loans from DECSI through the group loan scheme or individually via the extension package scheme. In the first case, farmers form groups consisting of at least three individuals who are collectively and individually held responsible for any loan default. In the second case, farmers who are members of the extension package program of their sub-districts get individual credit

access provided that they would use the money for components of the extension package including purchase of fertilizers, improved seed, livestock and modern bee hives. As of the production and harvest year under consideration (1999/2000 E.C or June 2007- April 2008), the annual interest rate of DECSI was 9%.

The second way through which rural households can acquire credit is trade credit from a farmer's cooperative. The Enderta Farmers Cooperative Union is the sole provider of fertilizers and improved seeds in the district. Member farmers can get fertilizers, improved seeds and even consumables such as sugar on credit basis.

Figure 4. 14: Household head's use of credit by gender



Source: Survey 2009

Generally, 68 % (n=85) of the total household heads in the survey have taken out loan in the production and harvest year under consideration (Fig. 4.14). The gender-wise distribution shows that 85% (23 out of 27) of the total female-headed households and 63% (62 out of 98) of the male-headed households have taken out loans. Almost all of the borrowers (n=83 out of 85) have acquired the credit from DECSI, either in the form of group loan scheme or the package scheme. The heavy dependence of borrowers on the microfinance institution is not without a reason. Most respondents referred the reason to be the fair interest rate (9%) the institution charges. Out of the 85 credit beneficiaries, 94% (n=80) feel that the interest rate is either affordable or cheap. This fact is further strengthened by the fact that 79 (93%) out of 85 household heads have managed to settle their debts in the first year either partially or fully.

Out of the 40 respondents who did not take out credit, the majority (n=22) had to depend on other financing alternatives whereas some (n=16) claimed to have refrained themselves due to fear of failure in repaying the credit. Only few respondents failed to take credit solely due to the perceived high interest rate.

Table 4. 8: Mean Amount Borrowed by Gender

Amount borrowed	Obs	Mean	Std. Dev.	Min	Max
Female	27	1928.889	1451.443	0	5000
Male	98	1459.204	1616.685	0	10000
Combined	125	1560.656	1588.694	0	10000

Source: Survey 2009

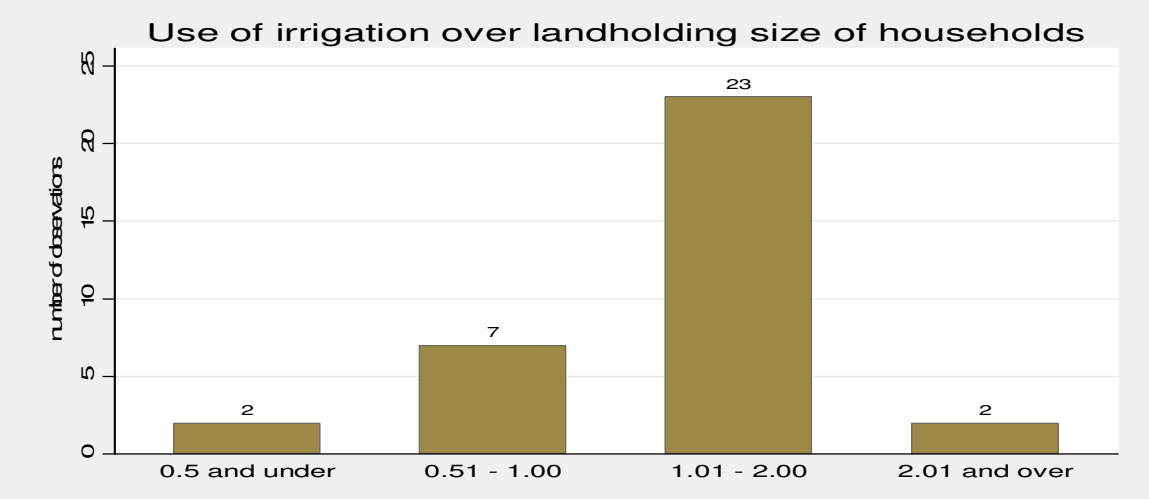
The statistical summary in Table 4.8 depicts that a typical household head has, on average, borrowed birr 1560.66 with around 40 households borrowing nothing at all while others have borrowed up to birr 10,000. It is worth noting here that the mean amount borrowed is higher for female-headed households; the **two-sample t test** result shows that the difference is statistically significant at the 10% level (see Annex C, Table 3.1). This gender-wise difference in the mean amount of loan borrowed can be attributed to the statistically significant difference (at 1% level) in oxen ownership between female-headed and male-headed households (see Annex C Table 3.2). Male-headed households own more oxen, on average, than their female counterparts. Similarly, statistically significant difference is observed between households who are members of farmer's cooperatives and the extension package program of their respective sub-districts; those who had taken part in cash crop production; those who applied irrigation; those who used improved seed; and those who did not belong to any of these categories. Accordingly, households that belonged to a farmer's cooperative (at 10%), an extension package (at 1%) and those who produced cash crops (at 5%), used improved seed (at 5%) and applied irrigation (at 1%) borrowed, on average, more money than their respective counterparts. (See Annex C Table 3.2)

Generally, out of the 85 household heads who took out credit, more than half (55%) invested the money for the purchase of livestock, mainly oxen and chicken, while the 35% invested the money in the purchase of fertilizers and improved seeds. The remaining 10% spent the money for non-agricultural purposes.

Use of Irrigation

Irrigation is a rare phenomenon of agricultural production in most parts of Africa (World Bank, 2007:15). What is now covered by irrigation is but a very small portion of what is potentially irrigable area in most countries (World Bank, 2007:15). However, use of irrigation is one important way to enhance agricultural production and market participation; these would in turn contribute to food security and increased income.

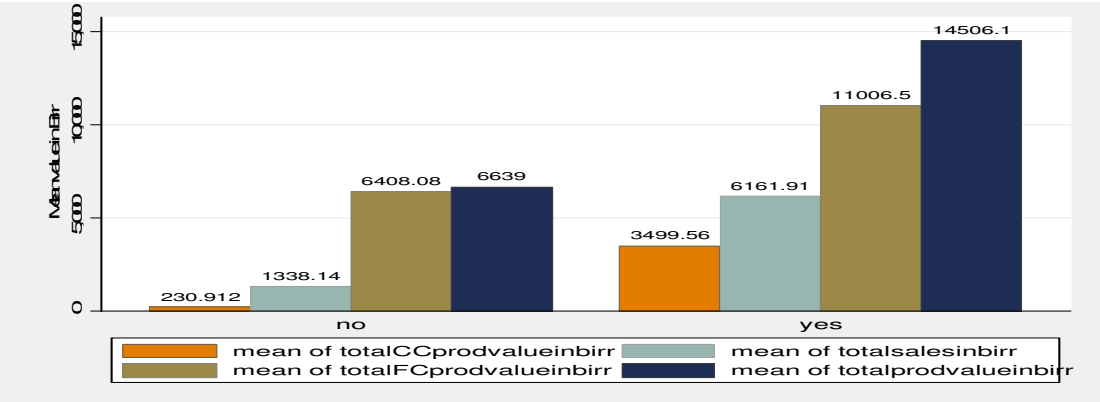
Figure 4. 15: Use of Irrigation by Landholding Size



Source: Survey 2009

There are, in total, 34(27%) households cultivating their land using irrigation technology whereas the remaining 91 (73%) households have not embraced this technology yet. As can be seen from Fig. 4.15, there is an increasing trend in the application of irrigation as one goes from small landholding size to large landholding size. This is further strengthened by the **chi-square test** showing that irrigation use and land holding size are related (Pr = 0.001). The case that there are only two irrigation applicants with landholding size of more than two hectares is because these are the only households in the whole sample households. Most of those who cultivated using irrigation (n=26) were dependent on river/stream diversion while the rest have either depended on dam or boreholes.

Figure 4. 16: Food, Cash and Total Crop Production Value and Total Sales by Irrigation Use



Source: Survey 2009

It is vividly depicted in fig.4.16 that irrigation users are, on average, better-off in terms of the harvest (in birr) they have secured from food crop, cash crop and total crop production. A **two-sample t test** between irrigation users and non-users provides clear evidence that irrigation users have better harvest (in value terms) at the 1% significance level in all three categories: food crop, cash crop and total crop production. (See Annex C Table 4.1-4.3)

4.2.5 Livestock Endowment of the Household Heads

Table 4. 9: Livestock endowment of household heads

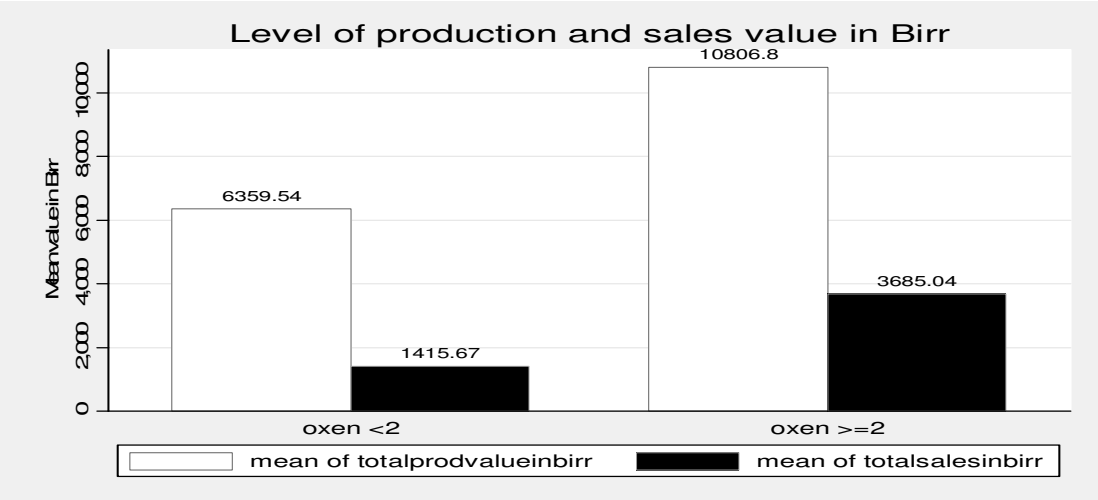
Livestock	Obs	Mean	Std. Dev.	Min	Max
Cows	125	1.136	.944799	0	4
Oxen	125	1.608	1.190663	0	7
Calves	125	.768	1.032816	0	4
Donkey	125	.72	.5764183	0	2
Goats	125	.152	1.016445	0	9
Sheep	125	.896	2.047122	0	10
Chicken	125	4.568	4.621716	0	20

Source: Survey 2009

Rural Ethiopia in general and Tigrai in particular is characterized by the practice of mixed farming except for certain areas known for their nomadic pastoralist lifestyle. This is also the case in the context of Enderta district of Tigrai (see table 4.4). Ownership of oxen, in particular, is a very important aspect in agricultural production of households given the poor

resource endowment and thus the lack of modern farm input technology by the rural people. Farmers with large number of oxen enjoy higher level of crop production and more likelihood of going commercial. According to table 4.9, a typical household head owns one cow, two oxen, one calve, one donkey, one sheep and five chickens. However, there are instances when a household head may not own any one of these animals or could, to the other extreme, own up to four cows, seven oxen, ten sheep and 20 chickens.

Figure 4. 17: Level of production and sales value (in birr) by oxen ownership



Source: Survey 2009

A **two-sample t test** result revealed that the level of total crop production (in value terms) and total sales value are strongly and positively associated (at the 1% level of significance) with the number of oxen owned by household heads (see Annex C Table 5.1-5.2). Fig. 4.17 depicts this strong association through a visual aid.

However, it is worth noting here that revenue from livestock sales is expected to be negatively associated with the likelihood of participation in the output market since livestock sales would cover cash needs of the households provided the households are mainly food crop producers.

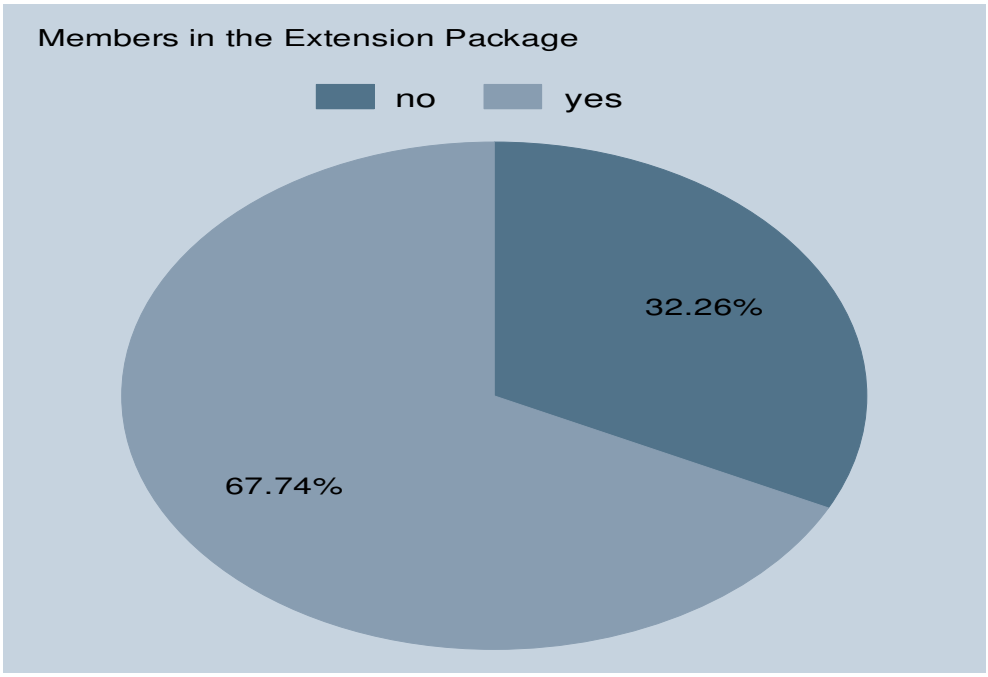
4.2.6 Household Head's Access to Extension Services

One way to transform subsistence-oriented farming in to market-oriented farming system is through the provision of extension services. Extension services extend from the provision of technical advice on farming issues such as what to produce, how to produce and when to

produce to facilitating credit availability and input supplies and even to the provision of market information and capacity building training to farmers.

Findings from the in-depth interview with agricultural experts of the sub-districts in Enderta District indicate that membership in the extension package program is solely based on voluntary basis. Farmers who join the extension package program can benefit from the technical advice they can get from agriculture and rural development experts; easy access to credit; capacity building training services; and other related services.

Figure 4. 18: Proportion of HH Heads in the Extension Package



Source: Survey 2009

A large proportion (about 68%) of the household heads represents members of the extension package program of the Enderta District while the remaining 32% are not (Fig. 4.18). A t**wo-sample t test** result shows that membership in an extension package program is strongly and positively associated with total cash crop production value (at 5%), total crop production value (at 10%), total crop sales (at 5%) and the degree of commercialization (at 10%). (See Annex C Table 6.1-6.4)

4.2.7 Access to Transport Infrastructure and Market Information

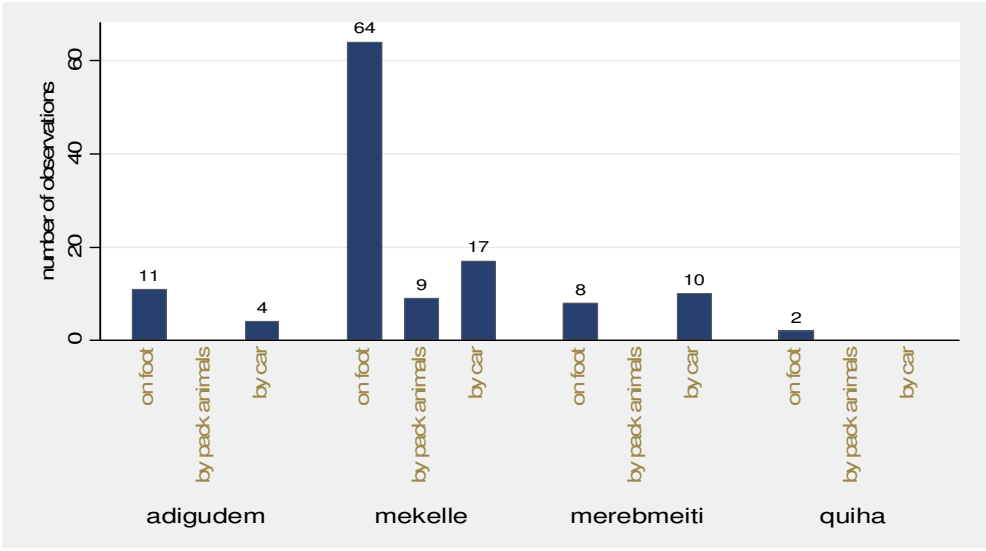
Access to Transport Infrastructure

Perhaps access to transport infrastructure is among the critical factors that affect commercialization of agriculture. Smallholder farmers with close proximity to roads and easy access to transport are better integrated to the market than their counter parts. In Africa, inadequate access to transport infrastructure is one major barrier to market access (World Bank, 2007:17).

Fortunately, all the sampled sub-districts in this study are located in close proximity to Mekelle, the capital city of the Tigrai Region. All are found in the range of three to thirty kilometers far from Mekelle. However, Debri and Shibta do not have direct access to transport. Household heads from Debri have to travel some three kilometers on foot or by pack animals till the pickup point for city taxi-minibuses while households from Shibta have to travel around three kilometers to the nearest pick up point for motorized transport destined either to Mekelle or afar away sub-city of Mekelle, Quiha.

Surprisingly, there is no statistically significant difference in the mean total crop sales of households with direct access to transport and those without direct access. The possible justification for this unexpected relationship is close proximity of Debri and Shibta to Mekelle even if the farmers have to travel on foot; in both cases, it is a maximum of one hour's walk to the market center.

Figure 4. 19: Nearest markets by mode of travel



Source: Survey 2009

There are four market destinations for households participating in the output market (see Fig. 4.19). Mekelle is the largest market destination accounting for 72% of the total respondents. Merebmeiti, a local market for households in Didba sub-district; Adigudem, a small town near Didba; and Quiha, a sub-city of Mekelle and market destination for households from Shibta, are the other market destinations and account for about 14%, 12% and 2% of the total respondents respectively.

Market Information

Needless to say, market information is another important factor in the commercialization of farming. Farmers need information pertaining output prices so as to make the right decision, ahead of the production season, regarding which type of crops to produce and sell and which crops to purchase from the market. In the post harvest season, farmers need to know the market price of outputs before they actually travel to the market. Neighbors, traders and the market itself serve as the main sources of market information for the Ethiopian farmer (MEDaC, 1998 cited in Mahlet, 2007:12).

Table 4. 10: Source/Means of acquiring market information by response rate

Source/Means of Acquiring Market Information	Response Rate				Total	
	Yes		No		Freq.	%
	Freq.	%	Freq.	%		
Visiting the Market in Person	75	60.0	50	40.0	125	100
Neighbors	123	98.4	2	1.60	125	100
Traders (middlemen)	6	4.8	119	95.2	125	100
Extension Agents	8	6.4	117	93.6	125	100
Radio	64	51.2	61	48.8	125	100
Mobile	6	4.8	119	95.2	125	100
TV	3	2.4	122	97.6	125	100

Source: Survey 2009

The main sources/means of getting information for the sampled households are found to be neighbors (98.4%), personal market assessments (60%), and weekly market information broadcast from a local radio (51.2%). Very few respondents depended on or have acquired market information from the other sources. This indicates that agricultural extension agents have not integrated provision of market information as one component of the extension

package. Majority of the farmers are not yet mobile users mainly due to the high cost of subscription and partly due to the lack of availability of the service in rural areas.

4.2.8 Crop Production, Sales and Degree of Commercialization

Table 4. 11: Statistical Summary of crop value produced and sold (in Birr)

Variable	Obs	Mean	Std. Dev.	Min	Max
Value of food crop produced per capita	125	7658.857	4317.003	1980	25790
Value of cash crop produced per capita	125	1119.984	2618.951	0	15140
Value of total crop produced per capita	**125**	**8778.841**	**5915.012**	**1980**	**37440**
Value of food crop sold per capita	125	1683.184	2058.056	0	9600
Value of cash crop sold per capita	125	967.024	2422.556	0	11650
Value of total crop sold per capita	**125**	**2650.208**	**3472.391**	**0**	**18450**
Degree of Commercialization	**125**	**22.71624**	**19.5148**	**0**	**67.74442**

Source: Survey 2009

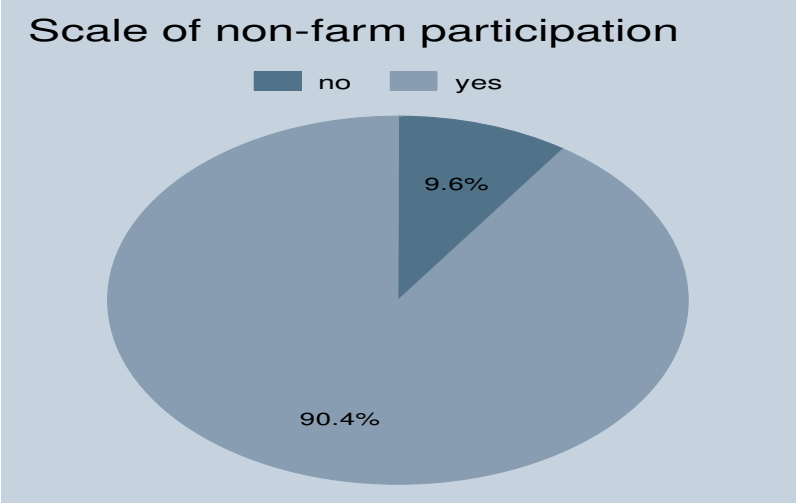
The statistical summary given in table 4.11 shows that a typical household head produced food crops valued approximately birr[2] 7,658 and cash crops valued approximately birr 1,120 with total production ranging from birr 1,980 to 37,440. From sells dimension, a typical household head, on average, sold food crops worth birr 2058 and cash crops worth birr 2,423 with total sales ranging from selling nothing to birr 18,450. The degree of commercialization (which is defined as the ratio of the gross value of all crop sales to the gross value of all crop production times hundred) for the typical household head is computed to be 22.72% ; the most commercialized household head sold about 68% of the gross value of its total cash crop production. The level of commercialization in the study areas at hand is lower than the national average which ranges from 33-36% (EEA 2004 cited in Samuel and Sharp 2007:65). This indicates that the level of commercialization in the study areas is very low even in comparison to the national average, which is in itself considered to be low.

[2] One United States Dollar (USD) is equivalent to approximately 11 birr (as of 2009).

4.2.9 Household Head's Participation in Non-farm Activities

In rural Africa, many households obtain half or more of their income from non-farm sources (Reardon 1997, Ellis 2006 cited in Leavy and Poulton, 2007:7). Though all the household heads in this survey are primarily engaged in crop production or mixed farming, a lot of them have also participated in non-farm activities. Non-farm activities refers both to self-employment in non-farm sectors such as petty trade, craft work/carpentry, stone mining, blacksmith, etc. or off-farm employment such as cash/food for work (safety net), masonry, daily labor, guard, etc. Participation in non-farm activities is expected to have negative relationship with total crop sales and degree of commercialization.

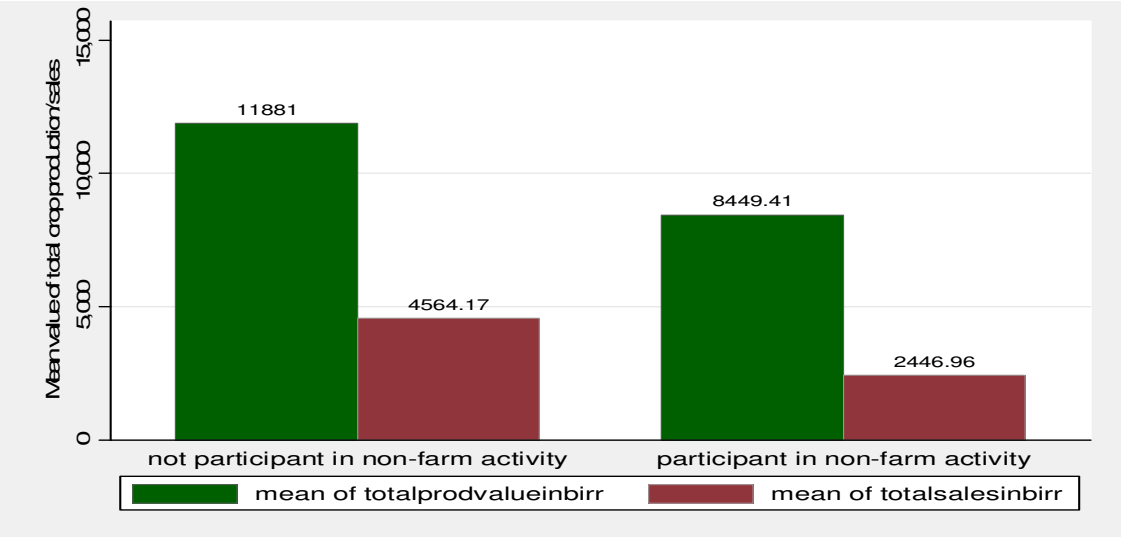
Figure 4. 20: Rate of participation in non-farm activities



Source: Survey 2009

The overwhelming majority (90.4%) of the household heads are participants in the non-farm economy (Fig. 4.20). The high rate of participation in the non-farm sector can be attributed mainly to the proximity of the sample areas to the largest city in the region, Mekelle, where employment opportunities are better (due to faster urban expansion), and the long time period farmers stay away from farming activities due to the heavy dependence of the majority on rain-fed agriculture.

Figure 4. 21: Mean Value of total crop produced and sold by non-farm participants



Source: Survey 2009

It can be visually observed from the preceding bar graph (fig. 4.21) that the mean value of total crop production and sales is lower for the non-farm participants in comparison to those who did not participate. The **two-sample t test** result has also strengthened this finding by showing that the difference in mean value produced and sold is statistically significant (at the 5% level) (See Annex C Table 7.1-7.2). This is not, however, unexpected; the non-participants in non-farm activities could have probably devoted all their time for crop production and thus harvesting higher production and selling more than their counterparts.

4.3 Commercialization and Welfare Outcomes: Descriptive and Statistical Analyses II

Samuel and Sharp (2007:67) noted that the ultimate objective of commercialization of agriculture is the attainment of better welfare outcomes for the smallholder farmer. Even though welfare is represented in terms of different things in different contexts, in this study welfare is represented by consumption of basic non-grain consumables (including sugar, coffee, salt and cooking oil); kerosene consumption; and expenditure on shoes and clothes, education, health care, durable goods (bed, mattress, radio, TV, mobile, etc), housing (iron sheets, buildings, etc) and farm implements (sickle, plow, pump, etc). Most of the variables representing welfare in this study are adopted from Samuel and Sharp (2007).

For the purpose of this study, degree of commercialization (DoC) is grouped into three categories: Low (<= 25% of output sold), Medium (26% - 50% of output sold) and High (> 50% of output sold). One-way ANOVA test is done to find out if there is statistically significant variation in welfare outcomes among farm households at the different levels of commercialization. Table 4.12 shows the test results.

Table 4. 12: Welfare outcomes for households with low, medium and high DoC

Welfare representative	Degree of Commercialization			Prob > F
	Low	Medium	High	
Consumption of basic non-grain consumables (Br/annum)	809.78	951.04	1160.7	0.0000***
Kerosene Consumption (Br/annum)	75.90	154.67	467.4	0.0492**
Expenditure on shoes and clothes (Br/annum)	941.42	1391.65	2080	0.0000***
Expenditure on education (Br/annum)	104.32	162.46	344	0.0000***
Expenditure on health care (Br/annum)	69.71	98.04	92	0.5052
Expenditure on durable goods (Br/annum)	240.25	409.78	1010	0.0159**
Housing expenditure (Br/annum)	635.86	1306.52	3629	0.0007***
Expenditure on farm implements (Br/annum)	48.75	349.11	86.2	0.1364
Number of observations	69	46	10	125

Source: Survey 2009

Note: ***1% significance level, **5% significance level, *10% significance level

Interestingly, farm households with a high degree of commercialization are better-off in terms of welfare outcomes than households with low level of commercialization. Table 4.12 reveals that consumption of basic non-grain consumables has a consistent increasing pattern along the commercialization index, low to high. This is also true with kerosene consumption and annual expenditure on shoes and clothes, education, durable goods, and housing. The one-way ANOVA test results confirms that the variation in consumption of basic non-grain consumables and kerosene; and annual expenditure on shoes and clothes, education, durable goods, and housing among farm households at different levels of commercialization is statistically significant at 1%, 5%, 1%, 1%, 5%, and 1% respectively (see Annex D).

Therefore, this result indicates that the higher the degree of commercialization, the better is the welfare status of farm households.

4.4 Commercialization of Smallholder Farming: An Econometric Analysis

In this section, an econometric analysis is performed to identify the household-level demographic and socio-economic factors that determine the decision of smallholder farmers to participate (or not) in the market and the level of their participation. First, the probit regression model is run to find out why some farm households participate in the market and others do not. Next, the Multivariate Linear Regression Analysis/Ordinary Least Square (OLS) estimation method is used to identify the decisive factors that determine the level of total crop sales of a given household head.

4.4.1 Determinants of market participation for the smallholder farmer

In this sub-section, a probit regression analysis is performed to find out what factors influence or determine for a smallholder farmer to participate or not. In probit regression model, the dependent variable is binary; that means it assumes only two values: 1 if the household is market participant and 0 if not. Households were considered participants if they sold crops worth any value above zero and non-participants if otherwise.

Several demographic and socioeconomic variables, which are believed to have an influence on the decision to participate in the market, are included in this analysis based on the findings in the literature. The explanatory variables that are expected to cause variation in the dependent variable are: Sex, Age, Literacy, Value of total crops sold, Total cultivated land size (including rented-in land) in Tsimdi[3], Household labor size (man-equivalent), Non-farm participation, Total income from non-farm activity, Total income from off-farm employment, Credit use, Irrigation Use, Improved seed use, Total income from livestock sales and number of Oxen owned.

[3] Four tsimdi are equal to one hectare.

Table 4. 13: Probit Estimates for Determinants of market participation (See Annex E)

Variable	Coef.	Std. Err.	z	P>|z|
Sex (1=male, 0=female)	.2083539	.5048824	0.41	0.680
Age (years)	.0021142	.0171813	0.12	0.902
Apply Irrigation (1=yes, 0=no)	1.318136	.6820596	1.93	0.053*
Use Credit	.1355022	.3983058	0.34	0.734
Household labor size (Man Equivalent)	.0444402	.17301	0.26	0.797
Oxen	.0275592	.2236717	0.12	0.902
Non-farm participation	-.4854739	.651169	-0.75	0.456
Literacy (1=literate, 0=illiterate)	-.6618196	.4198163	-1.58	0.115
Total value of crop produced	.0003351	.0000952	3.52	0.000***
Total land size (in Tsimdi)	.2014662	.1125548	1.79	0.073*
Use Improved Seeds (1=yes, 0=no)	.8196615	.3642965	2.25	0.024**
Total Income from livestock sales	.0000677	.0002553	0.27	0.791
Total income from non-farm self employment	.0001897	.000151	1.26	0.209
Total income from off-farm employment	.0002622	.0001662	1.58	0.115
Constant	-3.647947	1.304025	-2.80	0.005

Note: ***1% significance level, **5% significance level, *10% significance level

Log likelihood = -37.206646
LR chi2(14) = 90.06
Prob > chi2 = 0.0000
Pseudo R2 = 0.5476

Source: Survey 2009

The probit regression analysis disclosed that application of irrigation, level of crop production (in value terms), total land size and use of improved seeds are the variables that are statistically significant and have causal impact on the ability of a household to participate in the output market.

The probit regression result in table 4.13 reveals that irrigation use has a positive effect, at a significance level of 10%, on the ability of households to participate in the output market.

This seems reasonable since the majority of the farm households applying irrigation are cash crop producers and thus market-oriented.

The level of crop production (in value terms) is another important variable having significantly positive impact on the ability of smallholder farms to engage in output selling. It is statistically significant at 1% level indicating that households with high level of production tend to participate in the output market than those with lower production level.

The probit estimation also shows that total land size has a statistically significant (at 10% level) and positive influence on market participation of households. This could be due to the role of land size in boosting total production level and thus sales of surplus produce. Moreover, farm house holds with large land size could allocate their land partly for food crop production and partly for cash crop production giving them better position to participate in the output market.

Moreover, the use of improved seeds is found to have a statistically significant (at 5%) and positive influence on the ability of households to participate in the output market. Use of improved seeds enhances the agricultural productivity of smallholder farmers. With enhanced productivity, farmers have a better chance of achieving surplus production for sale.

Of those variables which are found to have insignificant impact on market participation, literacy is found to have unexpected negative sign. The possible explanation for this is the fact that the literate category mostly represents the young household heads; and these youngsters mostly own small sized land due to the distribution of land from generation to generation. Hence there is less likelihood for the young households to produce surplus and sell. Instead, they tend to meet their cash needs by engaging themselves in non-farm activities.

Table 4. 14: Probit regression, reporting marginal effects for market participation

Variable	dF/dx	Std. Err.	z	P>|z|	x-bar
Sex (1=male, 0=female)	.0285082	.0656025	0.41	0.680	.216
Age (years)	.0003143	.0025703	0.12	0.902	44.784
Apply Irrigation (1=yes, 0=no)	.13861	.0686637	1.93	0.053*	.272
Use Credit	.0208519	.0632913	0.34	0.734	.68
Household labor size (Man Equivalent)	.0066057	.0259111	0.26	0.797	2.8096
Oxen	.0040965	.0332838	0.12	0.902	1.608
Non-farm participation	-.0545523	.060105	-0.75	0.456	.904
Literacy (1=literate, 0=illiterate)	-.096164	.0700004	-1.58	0.115	.544
Total value of crop produced	.0000498	.0000202	3.52	0.000***	8778.84
Total land size (in Tsimdi)	.0299465	.0186604	1.79	0.073*	5.438
Use Improved Seeds (1=yes, 0=no)	.134442	.0790921	2.25	0.024**	.568
Total Income from livestock sales	.0000101	.0000369	0.27	0.791	1004.44
Total income from non-farm self employment	.0000282	.0000245	1.26	0.209	1526
Total income from off-farm employment	.000039	.0000295	1.58	0.115	885.36
obs. P pred. P |	.632 .9200168 (at x-bar)				
Log likelihood = -37.206646				LR chi2(14) = 90.06 Prob > chi2 = 0.0000 Pseudo R2 = 0.5476	

Source: Survey 2009

The marginal effect report of the probit regression provides the probability that a farm household will participate in output markets. Table 4.14 provides the probability estimation for the likelihood of market participation of a farm household given the statistically

significant variables: irrigation use, value of total crop produced, total land size and use of improved seeds.

The marginal effect shows that there is a probability of approximately 14% that a smallholder participates in the output market if he/she manages to become an irrigation user. Similarly, the likelihood that a smallholder farmer will participate in an output market as a result of a one birr increase, at mean value, in the total value of crop production is given by .005%. In other words, if the crop production value of a farmer increases by birr 1000, at mean value, then the likelihood of participation in the market increases by 5%. Moreover, the marginal effect report of the probit regression in table 4.14 indicates that there is a probability of 12% (3% for a Tsimdi) that a farmer participates in the output market if his/her land holding size increases, at mean value, by one hectare. Finally, the regression result shows that if a farmer shifts from being a non-user to being a user of fertilizer, then there is 13.4% likelihoods that he/she would take part in the output market.

4.4.2 Determinants of the level of total crop sales for the smallholder farmers

In this sub-section, multivariate linear regression analysis is performed to identify the decisive factors affecting the amount of total crops (in value terms) that smallholder farmers supply to the market. It is worth mentioning at this stage that only farm households who participated in the market as sellers are considered in this analysis since the objective is to identify what factors determine for a household to sell more or less of its crop production in the market.

Even though it was initially planned to measure the level of market participation using degree of commercialization (DoC) (measured in terms of the ratio of gross value of output sold to gross value of output produced), the researcher has opted to use 'total value of crops sold' in place of DoC for convincing reasons that Samuel and Sharp have stipulated in their paper (2007:72). According to these researchers, it would be inappropriate to use DoC when there is a risk of misinterpretation as when a farmer producing 100 quintals and selling 50 of it will have lower DoC value than a farmer producing five quintals and selling most or all of it. Hence, the researcher has opted to use the **total/gross value of all crops sold** as the dependent variable for the OLS estimation given below.

Several of a farm household's demographic and socioeconomic factors are hypothesized to explain the variation in total/gross value of crops sold. These include gender, age, education, total cultivated land size (including rented-in), total value of food crops produced, total value of cash crops produced, use of irrigation, use of improved seeds, use of fertilizer, household labor force (man equivalent), number of oxen, membership in extension package program, livestock sales, transport access, participation in non-farm activities, and gross income from non-farm activities.

Table 4. 15: OLS Estimation Results for total value of crops sold

Variable	**Coef.**	**Robust Std. Err.**	**t**	**P>|t|**
Sex (1=male, 0=female)	840.0623	390.8951	2.15	0.035**
Age (years)	20.09615	18.07309	1.11	0.270
Education (years)	158.9815	100.28	1.59	0.118
Total land size (in Tsimdi)	34.75425	69.3937	0.50	0.618
Total value of food crops produced	.2579017	.0582682	4.43	0.000***
Total value of cash crops produced	.7633203	.1010041	7.56	0.000***
Use Improved Seeds (1=yes, 0=no)	638.6931	323.7228	1.97	0.053*
Apply Irrigation (1=yes, 0=no)	747.2285	437.084	1.71	0.092*
Household labor size (Man Equivalent)[4]	36.90518	204.6558	0.18	0.857
Oxen	451.266	170.917	2.64	0.010***
Member of Extension Package (1=yes, 0=no)	424.6637	395.5026	1.07	0.287
Non-farm participant (1=yes, 0=no)	-130.5391	539.9188	-0.24	0.810
Livestock sales in birr	-.0716308	.0537464	-1.33	0.187
Use Fertilizer (1=yes, 0=no)	1158.169	619.4804	1.87	0.066*
Transport access (1=yes, 0=no)	525.5911	437.1829	1.20	0.233
Gross non-farm income	-.0286666	.0792653	-0.36	0.719
Constant	-4710.385	1743.163	-2.70	0.009
Note: ***1% significance level, **5% significance level, *10% significance level **F(16, 68) = 29.38 Prob > F = 0.0000 R-squared =0.8674 Root MSE = 1462.6**				

Source: Survey 2009

[4] See Annex G for the conversion factors used in calculating man-equivalent labor units.

The OLS estimation result (see Table 4.15) shows that about 87% (**R-squared =0.8674)** of the variation in the dependent variable, **total value of all crops sold**, is explained by the variation in the explanatory variables incorporated in the model. The over all significance and fitness of the model can be checked with the F value; accordingly, **Prob > F = 0.0000** indicates that the independent variables reliably predict the dependent variable. Initially, the model result revealed that there was problem of hetroskedasticity. However, the robust action was taken to remedy the problem. Moreover, the VIF, LINK and OV tests are performed to see if the model suffers from the problem of multicollinearity and incorrect specification. These tests show that the model is free from such problems. (See Annex F)

According to Table 4.15, seven of the explanatory variables have statistically significant relationship with the dependent variable. These are sex (at 5%), total value of food crops produced (at 1%), total value of cash crops produced (at 1%), use of improved seed (at 10%), use of irrigation (at 10%), oxen (1%) and use of fertilizer (at 10%). All these variables show up with the hypothesized signs.

The OLS estimation indicates that sex has a significant and positive relationship (β=840, p=0.035) with level of total crop sales in the market. Accordingly, total value of crops sold is higher by birr 840 if the household head is male. This could be due to the heavy domestic responsibilities women are shouldered with in the context of Tigrai in general and the study areas in particular. That is, women have to spend a great deal of their time doing domestic affairs and allocate very limited time for other matters including marketing transactions. Other possible explanation could be related to the case that many smallholder farmers travel to the market on foot (see fig. 4.16) and this requires physical fitness to travel long distance frequently for which men are better fit than their counterparts.

The amount of total food crop production (β=.25, p=0.000) and total cash crop production (β=.76, p=0.000) (in value terms) is also strongly and positively related with total value of crops sold as it was expected. As food crop and cash crop production increases by one birr each, total crop sales increase by birr .25 and .76 respectively.

The regression result also reveals that use of improved seeds has a significant and positive impact (β=639, p=0.053) on the level of total crop sales. This is so because use of improved seeds yields higher production keeping other things constant. Moreover, the case that

improved seeds are perceived to be of high quality crops results in high demand and possibly higher selling price for the crop. Hence, the total value of crops sold is higher by birr 639 for a household head using improved seeds in comparison to the non-user, keeping other things constant.

Irrigation use is another factor having significant and positive impact (β=747, p=0.092) on level of total crop sales which is in line with the expectation of the researcher. Most farm households using irrigation are market oriented and produce high value cash crops to the market. Moreover, the majority of them harvest two times in a year. This would obviously boost their crop production level. Hence, it would be reasonable to expect that such households would have higher level of crop sales. The regression result indicates that total crop sales for a typical irrigation user is higher by birr 747 from the non-user, keeping other things constant.

Farm households in Tigrai are very much dependent on the use of oxen for crop cultivation. The regression result reveals that the number of oxen owned significantly and positively influences (β=451, p=0.010) the level of crop sales. Accordingly, the level of crop sales increases as the number of oxen owned increases. The logical explanation for this fact is that households with large number of oxen usually enter into crop-sharing agreements with poor households having no ox at all. This boosts the level of crops available for sale. Another possible explanation is that farmers with large number of oxen benefit in two ways: by increasing their response to rains and through provision of manure; this, in turn, results in higher yields and surplus production for sale (Leavy and Poulton, 2007). Hence, if the number of oxen owned increases by one unit, sales level increases by birr 451.

Finally, use of fertilizer is found to be positively and significantly (β=1158, p=0.066) related to the level of crop sales. According to the regression result, farm households using fertilizer exhibit higher level of sales than non-users. Given the aridity and soil degradation of the environment in the study areas, fertilizer use becomes an important element of the production system and this application of fertilizers boosts productivity. Households with surplus production are highly likely to sell at least their surplus production. The regression coefficient for use of fertilizer indicates that a typical household's total crop sales value is higher by birr 1,158 compared to the non-user, keeping other things constant.

The coefficients of all the variables that are not statistically significant have the expected sign except age. Age was expected to have a negative sign given the fact that the young household heads are more close to information and better educated. The justification for this could be that older households may have acquired better experience on crop selection and market interactions through time.

CHAPTER FIVE: CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Conclusions

Commercialization of smallholder farming is getting priority in the developing world in general and Ethiopia in particular. This prioritization of smallholder farming has been reflected in the policy agenda of many developing countries. The Plan for Accelerated and Sustainable Development to End Poverty (PASDEP), the second poverty reduction strategy paper for Ethiopia, is such an example.

In Ethiopia, smallholder farmers cultivate approximate to 95% of the total cropped land and produce more than 90% of the total agricultural output. Given the agricultural led industrialization strategy for development and the dominance of smallholder agriculture in Ethiopia, it becomes imperative that smallholder farmers be transformed from the subsistence based production to market oriented production system. However, the degree of agricultural commercialization is at its infant stage in Ethiopia which is given by the national average of 33 to 36% in 2004.

The findings in this study showed that majority of the households covered in this study are mainly dependent on agriculture for their livelihoods. Most (77.6%) of them are engaged in mixed farming; and most (62.4%) of these produce exclusively food crops for own consumption. This indicates that the majority of the households are subsistence-oriented. The statistical findings showed that landholding size, irrigation use, number of oxen owned and membership in the extension package program have positive and statistically significant association with the total value of crop produced and sold, and the degree of commercialization; land slope is also positively and significantly associated with the degree of commercialization; and non-farm participation is statistically significant but negatively associated with the total value of crops produced and sold.

The average household sold about 23% of its total production (in value terms). This figure is quite smaller than the national average of 33-36%. This is a vivid indicator of the low level of commercialization in the study area despite the unique advantage of their proximity to the

largest city in the region, Mekelle. In absolute terms, the average household sold crops amounting to birr 2650 per annum (approximately USD 241.00).

Out of the total respondents, the majority (69%) participated in the output market while the rest (31%) did not participate at all. The findings from the probit regression analysis revealed what factors affect the decision or willingness of smallholder farmers to participate in the market. Accordingly, four factors were found to have significant impact on the decision of smallholders to participate in the output market; namely, production level (in value terms) at 1%, total land size at 10% and use of technology (use of irrigation at 10% and use of improved seeds at 5%).

The multivariate linear regression analysis was performed to identify those factors that determine the level of commercialization of smallholder farm households who are already market participants. The level of total value of crops sold vary from household to household; some with as high as birr 18,450 gross value of crops sold and others with as low as birr 600 gross value of crops sold. The findings from the regression analysis showed that sex of the household head (at 5%), food crop production level (in value terms) and cash crop production level (both in value terms and at 1%), use of technology (application of irrigation at 10%, improved seeds at 10% and fertilizer at 10%) and number of oxen owned (at 1%) were the determinant factors in the variation in gross value of crops sold among the households.

Finally, this study found out that farm households with high degree of commercialization (measured by the ratio of gross value of output sold to gross value of output produced) are better-off in welfare outcomes than those with low degree of participation. A one-way ANOVA test was performed to see if any significant difference existed among the households at different degree of commercialization. Accordingly, households with high degree of commercialization have higher consumption of basic non-grain items (such as sugar, salt, coffee and cooking oil); higher expenditure on shoes and clothes, education, durable goods, and housing. All these factors were found to be statistically significant: consumption of basic non-grain items (at 1%); and expenditure on shoes and clothes (1%), education (1%), durable goods (5%) and housing (1%).

5.2 Policy Implications

The findings discussed above provide the following policy implications:

- Existing government direction to transform smallholders from subsistence-oriented to market-oriented production system is proving to have an encouraging result by way of enhancing the welfare outcomes of those smallholders actively participating in the market. However, a lot needs to be done to enhance the level of commercialization since the overwhelming majority of smallholders are not well integrated with the market yet.

- There is still the potential of integrating non-participant farm households with the market if better support services in the form of technical advice and capacity building training to use technology and intensify production are provided; if additional funds for agricultural research activities dealing with high-yield seed varieties are allocated (for example, there is no improved variety of barley despite its wide spread use); and if investments in irrigation projects (such as river diversion and dams) are made. The better welfare outcomes for highly commercialized households justify such investments.

- Better credit services for households with marginal land holding size (let say those with .25 hectares) could create a viable condition to exit from subsistence oriented farming and join the newly emerging rural non-farm entrepreneurship while at the same time allowing others to lend-in additional land. The empirical results (see Table 4.13) indicating the importance of land size as a determinant factor for market participation justifies such an intervention.

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Appendices

Annex-A: Household Survey Questionnaire

Household Survey Questionnaire

"Commercialization of Smallholder Farming: Determinants and Welfare Outcomes"

(A Case study in Enderta Wereda/District of Tigrai, Ethiopia)

Household Level Survey Questionnaire

Purpose: This questionnaire is prepared with the aim of collecting data pertaining to market participation of rural households and welfare outcomes of their participation. This questionnaire will serve as a major input for the master thesis research being conducted in pursuit of purely academic purpose. Hence, the respondent is kindly requested to provide us his/her genuine responses to the sets of questions included herewith in the questionnaire. We would like to firmly assure the respondent on the confidentiality of the responses. Thank you in advance for your cooperation!!!

Woreda/District _____

Tabia/Sub/district _____

Kushet /Village _____

Interviewer's Name_____

Date of interview _____

A. DEMOGRAPHIC CHARACTERISTICS

HH member[1]	Sex (0=Male, 1=Female)	Age (in years)	Education (in years of schooling)	Marital Status[2]	Religion [3]
HH Head					

[1]HH= Household

Codes

General code 99 = Not applicable

[2] Marital status
1= Married
2= Single
3= Divorced
4= Widowed

[3] Religious background
1= Tewahido Orthodox
2= Catholic
3= Protestant
4= Muslim
5= other

B. SOCIO-ECONOMIC CHARACTERISTICS

B.1 Farm Characteristics

1. Do you have your own land?
    1. Yes
    2. No

(If your answer is "Yes", proceed to **Q#4**)

2. If your answer to **Q#1** is "No", how did you acquire the land you have cultivated in the last twelve months?
    1. via rent
    2. via crop sharing agreement
    3. From relatives (for free)
    4. From friends/neighborhood (for free)
    5. Other; specify _____

3. How large was the land holding size you have acquired via the method mentioned in **Q#2** (in Tsimdi[5]) _____.

4. If your answer to **Q# 1** is "Yes", have you acquired **land use title certificate** from the government?
    1. Yes
    2. No

5. How large is your land holding size in Tsimdi? _____.

[5] One Tsimdi is a quarter of a hectare

6. How do you describe the nature of the land you own or have cultivated in the last twelve months?
    1. Steeply Sloping
    2. Plain
    3. Mixed sloping

7. How do you describe the thickness of the land you have cultivated?
    1. Reguid/Thick
    2. Maekelay/Medium
    3. Rekik/Soft

8. How do you describe the nature of the soil you have cultivated in the last twelve months?
    1. Walka
    2. Hutsa
    3. Bakel
    4. Mekayiho
    5. Sheshiher

B.2 Farm Production Characteristics

9. What are the primary and secondary activities of the Household Head?

Primary Activity[1]	Secondary Activity[1]

Codes

General code 99 = Not applicable

[1] Activitiy

1=Crop production
2=Livestock rearing
3= Mixed farming (1+2)
4=Off-farm employment
5= Non-farm activities (self-employment such as trade)
6=Domestic activities
7= other

10. If the activity you are primarily engaged in is **crop cultivation** or **mixed farming**, then which of the following crops have you cultivated for the specified crop production year?

Type of crop produced	1=Yes 2=No	Primary reason for production *	Land devoted (in tsimad)	Crop Harvested (in qtl)	Crops sold in the year (in qtl)	Prices	
						SP per qtl	PP per qtl
Teff							
Barley							
Wheat							

*Primary reason for production
1= Own consumption
2= Selling to the market
3= Partial for consumption and partially for market
4= Other

11. How often do you cultivate your land in a given year?
1=Once in a year
2= Twice in a year
3= More than twice in a year

12. Have you **rented-in** additional farm land from other smallholder farmers?
1= Yes
2= No

13. If your answer to **Q#12** is "yes", how large is the **rented-in** land in Tsimdi? _____.

14. How do you rate the possibilities of **renting-in** land in your locality in terms of the following factors?
14.1 **Supply** of land rental
1= High 2= Medium 3= Low
14.2 **Cost**
1= High 2= Medium 3= Low

14.3 **Legal and Administrative** procedures
1= Easy 2= Difficult

15. Have you **rented-out** land to other smallholder farmers?
1= Yes
2= No

16. If your answer to Q#15 is "yes", how large is the **rented-out** land in Tsimdi? _____.

17. How do you rate the possibilities of **renting-out** land in your locality in terms of the following factors?
    17.1 **Demand for land rental**
    1= High 2= Medium 3= Low
    17.2 **Revenue generated/return**
    1= High 2= Medium 3= Low
    17.3 **Legal and Administrative procedures**
    1= Easy 2= Difficult

B.3 Farm Input and Technology Use

18. Which of the following farm inputs have you purchased and applied as of the production year?

S. N	Description		1. Yes 2. No	Qty in Kgs.	Cost[1]	Accessibility[2]	Source of financing[3]
1	Fertilizer	DAP					
		UREA					
		OTHER					
2	Improved Seed	1					
		2					
		3					
		4					

Codes
General code 99 = Not applicable

[1]Cost	[2]Accessibility	[3] Source of financing
1=Very high	1= Accessible	1= Own Savings
2=High	2= Not Accessible	2= Credit
3=Medium		3= Safety net
4=Low		4= remittance
5=Very Low		5= Other

19. If you are not applying any one of the above mentioned inputs, what are the possible reasons? _____

20. Have you been applying irrigation?
    1=Yes 2=No

21. If your answer to Q#20 is "Yes", what kind of irrigation do you use?
    1=Stream/river diversion
    2=Dam
    3=Borehole
    4=other; specify _____

22. Do you pay money for the use of irrigation?
    1=Yes 2=No

23. If your answer to Q#22 is "yes", how do you rate its affordability?
    1=Expensive
    2=Affordable
    3=Cheap

24. How often do you cultivate using irrigation?
    1=Once
    2=Twice
    3=Thrice
    4=More than thrice

25. Did you take out **credit/loan**?
    1= Yes 2= No
    (If your answer is "No", proceed to **Q#27**)

26. If your answer to **Q#25** is "No", what was the main reason?
    1= Lack of Access
    2= High interest
    3= Collateral requirement
    4= Availability of other alternatives
    5= other (please specify) _____

27. If your answer to **Q#25** is "yes", how much did you borrow? _____.

28. If your answer to **Q#25** is "yes", what was your **major source**?
    1= savings and credit institutions
    2= Informal creditors
    3= commercial banks
    4= other; _____

29. What did you do with the borrowed money?

S.N	Target Activity	1= Yes 2= No	Rank According to degree of expenditure (1= highest, 2=next highest, etc…)
1	Purchased Inputs such as fertilizer, improved seeds, etc		
2	Purchased Livestock		
3	Rented-in land		
4	Hired farm laborer		
5	Other (please specify)	5.1 5.2	

30. Have you been able to settle all or part of your loan?
    1=Yes, paid out all
    2=Yes, paid out partially
    3= No, not paid at all

31. How do you assess the cost of getting credit (interest and other charges)?
    1=Expensive
    2= Affordable
    3= Cheap

32. What did the **labor composition** of your **farm** look like in the last production year?

S.N	Participation in Farm activity	Number of persons
1	HH head	
2	Spouse	
3	Adult women (Age >=17)	
4	Adult men (Age >=17)	
5	Young girls (10-13)	
6	Young girls (14-16)	
7	Young boys (10-13)	
8	Young boys (14-16)	

B.4 Asset Endowments

33. How many of the following items do you own?

Assets owned		**Quantity in units**
Livestock	Cows	
	Oxen	
	Calves	
	Donkey	
	Goats	
	Sheep	
	Chicken	
	Bee (in # of hives)	
	Mulls or Horses	
Power Generator		

B.5 Social Capital

34. Are you a member of any **local organization or association**?
    1=Yes 2=No

35. If your answer for **Q#34** is "yes", which association do you belong to?
    35.1 **Farmer's Cooperative** 1= Yes 2= No
    35.2 **Savings and Credit Institution** 1= Yes 2= No

35.3 **Women's Association** 1= Yes 2= No
35.4 **Other (please specify):** _____

36. If your answer for **Q#34** is "yes", how does your membership benefit you?

S.N	Membership benefits	1= Yes 2= No
1	1.1 Fast Input Delivery	
	1.2 Affordable Input price	
2	2.1 Fair farm gate output price	
	2.2 strong bargaining power	
	2.3 reliable storage facility	
3	3.1 Easy access to credit	
	3.2 Low cost credit	
	3.3 Increased Savings Habit	

37. Are you a member of an ***Iqub*** (informal rotating group savings technique)?
1= Yes 2= No

38. If your answer for **Q#37** is "yes", is there a **culture of giving priorities** to members during their **emergency periods**?
1= Yes
2= No

B.5 Access to public Goods/Services

39. Are you a member of the agricultural extension package of your *Wereda/District/*?
1= Yes 2= No

40. If your answer for **Q#39** is "yes", which of the following services have you received so far?

S.N	Type of Good or Service Received	Yes	No
1	Technical advice		
2	Market Information (input or/and output)		
3	Credit		
4	Farm equipment		
5	Improved seeds		
6	Fertilizer		
7	Capacity building training		
8	Weather related/Metrological		

B.6 Infrastructure and Market Information

41. Who is the **major** buyer of your farm outputs?
    1= rural consumers
    2= cooperatives
    3= middlemen from towns
    4= urban consumers
    5= others (please specify): _____.

42. What is the nearest output market where you **mainly** sale your products?
    _____.

43. Do you have road access to the nearest town/city?
    1= Yes 2= No

44. If your answer for **Q#43** is "yes", what is the nearest town/city where you sale your products? _____.

45. Do you have transport access to the nearest town/city if you intend to sale products there?
    1= Yes 2= No

46. How do you get to the nearest output markets most often?
    1= on foot 2= by pack animals 3= by car

47. How much does it cost (roundtrip cost in Birr) if you have to travel by car?
    _____.

48. How many times do you travel, **on average in a year**, to the nearest town or city to sell your outputs? _____.
49. How much would you collect from sales (in birr) on average in a typical travel to the output market? _____.

50. How do you acquire market information pertaining output prices **most often**?

S. N	Means of Accessing Information	Have been using as a means		Degree of dependence[1] as a source of information	Reliability[2] of the source	Rank as 1st, 2nd, 3rd, etc according to frequency of use
		Yes	No			
1	Radio					
2	Government/Extension agents					
3	Television					
4	Mobile					
5	Traders/Middlemen					
6	Neighbors					
7	Other (specify					

Codes

General code 99 = Not applicable

[1]Degree of dependence	[2]Reliability	[3] Rank
1= High	1=High	1st, 2nd, 3rd…n
2= Medium	2= Medium	
3= Low	3= Low	

C. Household Income and Welfare Outcomes

C.1 Welfare Outcomes of Households

51. Non-food Expenditure/Consumption of Households in the last 12 months

S.N	Type of non-food consumed/purchased	Total Expenditures (in birr)
1	Coffee and sugar **per month**	
2	Salt **per month**	
3	Kerosene **per month**	
4	Food oil **per month**	
5	Clothes and Shoes **per year**	
6	Education **per year**	
7	Health **per year**	
8	Housing (eg. for iron-sheet cover) **(total in the last production year)**	
9	Farm implements (including generator)	
10	Durables (radio, bed, mattress, mobile, etc ……) **(total in the last production year)**	

52. How many times does your household consume **basic food on average in a day**?
    1= one time in a day
    2= two times in a day
    3= three times in a day
    4= more than three times in a day

C.2 Household Income

53. Estimation of household incomes from farm, off-farm and non-farm activities for the last twelve months

Item #2	Quantity sold in the year	Total Value earned from sales (in birr)
Livestock		

54. Did you participate in **non-farm activities/off-employment**?
    1= Yes 2= No

55. If your answer to **Q#54** is "Yes", how much did you receive as income from your participation?

S.N	Type of Activity	Self-employment	Off-farm employment	Total income earned in the year
1				
2				
3				
4				

Annex B: Key Informant Interview

Key Informant Interview

(With Agriculture and rural development experts)

A. Personal background

1. What is your job responsibility?
2. How long have you served in this sub-district/tabia and in what capacity?

B. Production, Marketing, and Farm Characteristics

1. What is the primary means of livelihoods for the people in this Tabia/sub-district?
2. What are the main food and cash crops grown in this Tabia/sub-district and why?
3. What services and assistance do the farmers get from your office?
4. What efforts are done to integrate the smallholder farmers with the market? What are the challenges and opportunities at their disposal?
5. What are the major non-farm activities farmers in your Tabia/sub-district are mainly engaged in?

Annex C: T-test and One-way ANOVA test results for the Descriptive Analysis I

Table1.1

. oneway totalprodvalueinbirr disbyholdingsize, tab

```
  RECODE of |
landsizeinH |   Summary of totalprodvalueinbirr
          a |        Mean   Std. Dev.       Freq.
------------+------------------------------------
  0.5 and u |   5658.1786    5053.178          14
  0.51 - 1. |   7035.8077   3951.7315          52
  1.01 - 2. |   10531.888   6136.2784          57
  2.01 and  |     25980.5   6336.3839           2
------------+------------------------------------
      Total |   8778.8408   5915.0117         125

                      Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups      1.0613e+09      3    353763018     13.06     0.0000
 Within groups      3.2771e+09    121   27083835.1
------------------------------------------------------------------------
    Total           4.3384e+09    124   34987363.7

Bartlett's test for equal variances:  chi2(3) =   8.9074  Prob>chi2 = 0.031
```

Table 1.2

. oneway totalsalesinbirr disbyholdingsize, tab

```
  RECODE of |
landsizeinH |     Summary of totalsalesinbirr
          a |        Mean   Std. Dev.       Freq.
------------+------------------------------------
  0.5 and u |   1803.5714    4089.972          14
  0.51 - 1. |   1715.7308   2346.4896          52
  1.01 - 2. |   3512.5965   3857.5481          57
  2.01 and  |        8295   1407.1425           2
------------+------------------------------------
      Total |    2650.208   3472.3911         125

                      Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups       161563035      3   53854345.1      4.89     0.0031
 Within groups      1.3336e+09    121   11021214.7
------------------------------------------------------------------------
    Total           1.4951e+09    124   12057500.1

Bartlett's test for equal variances:  chi2(3) =  13.2442  Prob>chi2 = 0.004
```

Table 1.3

```
. oneway     DoC2 disbyholdingsize, tab
```

```
  RECODE of |
landsizeinH |           Summary of DoC2
          a |        Mean   Std. Dev.       Freq.
------------+------------------------------------
  0.5 and u |   15.154273    26.64974          14
  0.51 - 1. |   19.359836    18.40003          52
  1.01 - 2. |   27.301878   17.904239          57
  2.01 and  |    32.22575   2.4433897           2
------------+------------------------------------
      Total |   22.716239   19.514798         125

                      Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups       2765.8319      3   921.943966      2.51     0.0620
 Within groups      44456.7581    121   367.411224
------------------------------------------------------------------------
    Total             47222.59    124   380.827339

Bartlett's test for equal variances:  chi2(3) =   6.5554  Prob>chi2 = 0.088
```

Table 2.1

```
. oneway     DoC2  landslope, tab
```

```
            |           Summary of DoC2
  landslope |        Mean   Std. Dev.       Freq.
------------+------------------------------------
  steeply s |           0           0           3
      plain |   21.005146   18.918263          78
  mixed slo |   27.298375   19.862295          44
------------+------------------------------------
      Total |   22.716239   19.514798         125

                      Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups      2700.27662      2   1350.13831      3.70     0.0275
 Within groups      44522.3134    122   364.936995
------------------------------------------------------------------------
    Total             47222.59    124   380.827339

Bartlett's test for equal variances:  chi2(1) =   0.1308  Prob>chi2 = 0.718
```

Table 3.1

```
. ttest  amtborrowed, by(sex)

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
    male |      98    1459.204    163.3099    1616.685    1135.079    1783.329
  female |      27    1928.889    279.3304    1451.443    1354.717    2503.061
---------+--------------------------------------------------------------------
combined |     125    1560.656    142.0971    1588.694    1279.406    1841.906
---------+--------------------------------------------------------------------
    diff |           -469.6848    344.1076               -1150.825    211.4551
------------------------------------------------------------------------------
    diff = mean(male) - mean(female)                              t =  -1.3649
Ho: diff = 0                                     degrees of freedom =      123

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0874         Pr(|T| > |t|) = 0.1748          Pr(T > t) = 0.9126
```

Table 3.2

```
. ttest oxen, by(sex)

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
    male |      98    1.816327    .1190351    1.178387    1.580075    2.052578
  female |      27    .8518519    .1746278    .9073929    .4928992    1.210805
---------+--------------------------------------------------------------------
combined |     125       1.608    .1064961    1.190663    1.397214    1.818786
---------+--------------------------------------------------------------------
    diff |            .9644747     .244856                .4797972    1.449152
------------------------------------------------------------------------------
    diff = mean(male) - mean(female)                              t =   3.9389
Ho: diff = 0                                     degrees of freedom =      123

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9999         Pr(|T| > |t|) = 0.0001          Pr(T > t) = 0.0001
```

Table 3.3

```
. ttest  amtborrowed, by( memfarmcoop)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      no |      47    1284.723    269.7227    1849.126    741.7997    1827.647
     yes |      78    1726.923    158.0078    1395.487    1412.289    2041.557
---------+--------------------------------------------------------------------
combined |     125    1560.656    142.0971    1588.694    1279.406    1841.906
---------+--------------------------------------------------------------------
    diff |           -442.1997    291.8378               -1019.875    135.4753
------------------------------------------------------------------------------
    diff = mean(no) - mean(yes)                                   t =  -1.5152
Ho: diff = 0                                     degrees of freedom =      123

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0661         Pr(|T| > |t|) = 0.1323          Pr(T > t) = 0.9339
```

```
. ttest  amtborrowed, by(  memextpackage)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      no |      40       349.5    128.0384    809.7861    90.51783    608.4822
     yes |      84    2138.119    169.6681    1555.034    1800.656    2475.582
---------+--------------------------------------------------------------------
combined |     124    1561.145    143.2469     1595.13    1277.597    1844.694
---------+--------------------------------------------------------------------
    diff |           -1788.619    261.6276               -2306.537   -1270.701
------------------------------------------------------------------------------
    diff = mean(no) - mean(yes)                                   t =  -6.8365
Ho: diff = 0                                     degrees of freedom =      122

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000

. ttest  amtborrowed, by(useirrigation)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      no |      91     1250.33    124.8066    1190.579     1002.38     1498.28
     yes |      34    2391.235     369.489    2154.472    1639.504    3142.966
---------+--------------------------------------------------------------------
combined |     125    1560.656    142.0971    1588.694    1279.406    1841.906
---------+--------------------------------------------------------------------
    diff |           -1140.906    303.6707               -1742.003   -539.8081
------------------------------------------------------------------------------
    diff = mean(no) - mean(yes)                                   t =  -3.7570
Ho: diff = 0                                     degrees of freedom =      123

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0001         Pr(|T| > |t|) = 0.0003          Pr(T > t) = 0.9999
```

Table 3.4

```
. tab  useirrigation disbyholdingsize, chi2

useirrigat |           RECODE of landsizeinHa
       ion | 0.5 and u  0.51 - 1.  1.01 - 2.  2.01 and  |     Total
-----------+--------------------------------------------+----------
        no |        12         45         34          0 |        91
       yes |         2          7         23          2 |        34
-----------+--------------------------------------------+----------
     Total |        14         52         57          2 |       125

          Pearson chi2(3) =  16.4670   Pr = 0.001
```

Table 4.1

```
. ttest   totalFCprodvalueinbirr, by(useirrigation)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      no |      91    6408.084    312.6237     2982.24    5787.002    7029.165
     yes |      34    11006.51    937.9571    5469.183    9098.227     12914.8
---------+--------------------------------------------------------------------
combined |     125    7658.857    386.1245    4317.003    6894.608    8423.105
---------+--------------------------------------------------------------------
    diff |           -4598.431    766.2479               -6115.172   -3081.691
------------------------------------------------------------------------------
    diff = mean(no) - mean(yes)                                   t =  -6.0012
Ho: diff = 0                                     degrees of freedom =      123

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

Table 4.2

```
. ttest   totalCCprodvalueinbirr, by(useirrigation)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      no |      91    230.9121    58.69512    559.9158     114.304    347.5202
     yes |      34    3499.559    705.1106    4111.466    2065.001    4934.117
---------+--------------------------------------------------------------------
combined |     125    1119.984    234.2461    2618.951    656.3453    1583.623
---------+--------------------------------------------------------------------
    diff |           -3268.647    438.7434               -4137.112   -2400.181
------------------------------------------------------------------------------
    diff = mean(no) - mean(yes)                                   t =  -7.4500
Ho: diff = 0                                     degrees of freedom =      123

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

Table 4.3

```
. ttest   totalprodvalueinbirr, by(useirrigation)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      no |      91    6638.996    325.2213    3102.414    5992.887    7285.105
     yes |      34    14506.07    1315.024    7667.843    11830.64    17181.51
---------+--------------------------------------------------------------------
combined |     125    8778.841    529.0547    5915.012    7731.693    9825.988
---------+--------------------------------------------------------------------
    diff |           -7867.078      960.12               -9767.577   -5966.579
------------------------------------------------------------------------------
    diff = mean(no) - mean(yes)                                   t =  -8.1938
Ho: diff = 0                                     degrees of freedom =      123

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

Table 5.1

```
. ttest   totalprodvalueinbirr, by( owenoxen)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
 oxen <2 |      57    6359.544    486.7623    3674.975    5384.442    7334.646
oxen >=2 |      68    10806.78    807.2399    6656.671    9195.523    12418.04
---------+--------------------------------------------------------------------
combined |     125    8778.841    529.0547    5915.012    7731.693    9825.988
---------+--------------------------------------------------------------------
    diff |           -4447.237    988.2868               -6403.49   -2490.984
------------------------------------------------------------------------------
    diff = mean(oxen <2) - mean(oxen >=2)                         t =  -4.4999
Ho: diff = 0                                     degrees of freedom =      123

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

Table 5.2

```
. ttest  totalsalesinbirr, by( owenoxen)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
 oxen <2 |      57    1415.667    287.6397    2171.632    839.4552    1991.878
oxen >=2 |      68    3685.044    484.9222    3998.771    2717.135    4652.953
---------+--------------------------------------------------------------------
combined |     125    2650.208    310.5801    3472.391    2035.483    3264.933
---------+--------------------------------------------------------------------
    diff |           -2269.377    591.7281               -3440.667   -1098.088
------------------------------------------------------------------------------
    diff = mean(oxen <2) - mean(oxen >=2)                         t =  -3.8352
Ho: diff = 0                                     degrees of freedom =      123

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0001         Pr(|T| > |t|) = 0.0002          Pr(T > t) = 0.9999
```

Table 6.1

```
. ttest   totalCCprodvalueinbirr, by( memextpackage)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      no |      40         440    255.7493      1617.5   -77.30174    957.3017
     yes |      84    1457.119    321.1718    2943.589    818.3212    2095.917
---------+--------------------------------------------------------------------
combined |     124    1129.016    235.9673     2627.62    661.9334    1596.099
---------+--------------------------------------------------------------------
    diff |           -1017.119    498.4111               -2003.774   -30.46457
------------------------------------------------------------------------------
    diff = mean(no) - mean(yes)                                   t =  -2.0407
Ho: diff = 0                                     degrees of freedom =      122

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0217         Pr(|T| > |t|) = 0.0434          Pr(T > t) = 0.9783
```

Table 6.2

```
. ttest   totalprodvalueinbirr, by( memextpackage)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      no |      40    7535.265    754.7907    4773.715    6008.557    9061.973
     yes |      84    9370.333    694.0486     6361.06    7989.899    10750.77
---------+--------------------------------------------------------------------
combined |     124    8778.376    533.3384    5939.006    7722.665    9834.087
---------+--------------------------------------------------------------------
    diff |           -1835.068    1133.474               -4078.894    408.7575
------------------------------------------------------------------------------
    diff = mean(no) - mean(yes)                                   t =  -1.6190
Ho: diff = 0                                     degrees of freedom =      122

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0540         Pr(|T| > |t|) = 0.1080          Pr(T > t) = 0.9460
```

Table 6.3

```
. ttest  totalsalesinbirr, by(  memextpackage)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      no |      40     1894.75    419.4364    2652.749     1046.36     2743.14
     yes |      84    3001.143    412.6102    3781.635    2180.478    3821.808
---------+--------------------------------------------------------------------
combined |     124    2644.242    313.0372    3485.835    2024.604     3263.88
---------+--------------------------------------------------------------------
    diff |           -1106.393     664.886               -2422.601    209.8154
------------------------------------------------------------------------------
    diff = mean(no) - mean(yes)                                   t =  -1.6640
Ho: diff = 0                                     degrees of freedom =      122

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0493         Pr(|T| > |t|) = 0.0987          Pr(T > t) = 0.9507
```

Table 6.4

```
. ttest   DoC2, by(  memextpackage)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      no |      40    18.61106    2.852953    18.04366    12.84041     24.3817
     yes |      84    24.48481    2.186891    20.04319    20.13517    28.83445
---------+--------------------------------------------------------------------
combined |     124    22.59005    1.754986    19.54269    19.11616    26.06394
---------+--------------------------------------------------------------------
    diff |           -5.873754    3.731928               -13.26148     1.51397
------------------------------------------------------------------------------
    diff = mean(no) - mean(yes)                                   t =  -1.5739
Ho: diff = 0                                     degrees of freedom =      122

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0590         Pr(|T| > |t|) = 0.1181          Pr(T > t) = 0.9410
```

Table 7.1

```
. ttest   totalprodvalueinbirr, by(   nonfarmparticipation)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
not part |      12       11881     2691.35    9323.109    5957.379    17804.62
particip |     113    8449.408    507.1054    5390.604    7444.644    9454.172
---------+--------------------------------------------------------------------
combined |     125    8778.841    529.0547    5915.012    7731.693    9825.988
---------+--------------------------------------------------------------------
    diff |            3431.592    1776.434               -84.75104    6947.935
------------------------------------------------------------------------------
    diff = mean(not part) - mean(particip)                        t =   1.9317
Ho: diff = 0                                     degrees of freedom =      123

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9722         Pr(|T| > |t|) = 0.0557          Pr(T > t) = 0.0278
```

Table 7.2

```
. ttest   totalsalesinbirr, by(   nonfarmparticipation)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
not part |      12    4564.167    1691.381    5859.116    841.4617    8286.872
particip |     113    2446.956     290.614    3089.269    1871.141     3022.77
---------+--------------------------------------------------------------------
combined |     125    2650.208    310.5801    3472.391    2035.483    3264.933
---------+--------------------------------------------------------------------
    diff |            2117.211    1041.195                56.22832    4178.194
------------------------------------------------------------------------------
    diff = mean(not part) - mean(particip)                        t =   2.0334
Ho: diff = 0                                     degrees of freedom =      123

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9779         Pr(|T| > |t|) = 0.0442          Pr(T > t) = 0.0221
```

Annex D: One-way ANOVA test results for the Descriptive Analysis II

. oneway basicnonfoodConsumption degreeofcommercialization, tabulate

```
  RECODE of |     Summary of basicnonfoodExp
       DoC2 |        Mean   Std. Dev.       Freq.
------------+------------------------------------
   doc<=25% |   809.78261   232.16537          69
  doc(26-50 |   951.04348   219.41285          46
   doc>=51% |      1160.7    279.5433          10
------------+------------------------------------
      Total |      889.84   252.13822         125

                      Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups      1348195.05      2   674097.524     12.58     0.0000
 Within groups      6534941.75    122   53565.0963
------------------------------------------------------------------------
    Total            7883136.8    124   63573.6839

Bartlett's test for equal variances:  chi2(2) =   0.9574  Prob>chi2 = 0.620
```

. oneway KeroseneExp degreeofcommercialization, tabulate

```
  RECODE of |       Summary of KeroseneExp
       DoC2 |        Mean   Std. Dev.       Freq.
------------+------------------------------------
   doc<=25% |   75.898551    50.46494          69
  doc(26-50 |   154.67391   559.68682          46
   doc>=51% |       467.4    1186.128          10
------------+------------------------------------
      Total |     136.208   477.68788         125

                      Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups      1363535.79      2   681767.897      3.09     0.0492
 Within groups      26931492.8    122   220749.941
------------------------------------------------------------------------
    Total           28295028.6    124   228185.714
```

. oneway ClothShoeExp degreeofcommercialization, tabulate

```
  RECODE of |       Summary of ClothShoeExp
       DoC2 |        Mean   Std. Dev.       Freq.
------------+------------------------------------
   doc<=25% |   941.42029   623.60094          69
  doc(26-50 |   1391.6522   844.07333          46
   doc>=51% |        2080   728.46871          10
------------+------------------------------------
      Total |    1198.192   789.68746         125

                      Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups      14046776.1      2   7023388.07     13.54     0.0000
 Within groups      63280403.2    122    518691.83
------------------------------------------------------------------------
    Total           77327179.4    124   623606.285

Bartlett's test for equal variances:  chi2(2) =   4.9818  Prob>chi2 = 0.083
```

. oneway EducExp degreeofcommercialization, tabulate

RECODE of DoC2	Summary of EducExp Mean	Std. Dev.	Freq.
doc<=25%	104.31884	101.99402	69
doc(26-50	162.45652	146.53535	46
doc>=51%	344	230.46812	10
Total	144.888	146.90117	125

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	524218.033	2	262109.017	14.86	0.0000
Within groups	2151696.4	122	17636.8557		
Total	2675914.43	124	21579.9551		

Bartlett's test for equal variances: chi2(2) = 16.7307 Prob>chi2 = 0.000

. oneway HealthExp degreeofcommercialization, tabulate

RECODE of DoC2	Summary of HealthExp Mean	Std. Dev.	Freq.
doc<=25%	69.710145	128.67722	69
doc(26-50	98.043478	138.31718	46
doc>=51%	92	93.903023	10
Total	81.92	129.80995	125

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	23261.0841	2	11630.542	0.69	0.5052
Within groups	2066216.12	122	16936.1977		
Total	2089477.2	124	16850.6226		

Bartlett's test for equal variances: chi2(2) = 1.8816 Prob>chi2 = 0.390

. oneway DurablesExp degreeofcommercialization, tabulate

RECODE of DoC2	Summary of DurablesExp Mean	Std. Dev.	Freq.
doc<=25%	240.24638	640.18036	69
doc(26-50	409.78261	875.86526	46
doc>=51%	1010	1224.0643	10
Total	364.216	809.22655	125

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	5326304.53	2	2663152.27	4.28	0.0159
Within groups	75874798.6	122	621924.579		
Total	81201103.2	124	654847.606		

Bartlett's test for equal variances: chi2(2) = 10.7535 Prob>chi2 = 0.005

. oneway HousingExp degreeofcommercialization, tabulate

```
  RECODE of |        Summary of HousingExp
       DoC2 |        Mean   Std. Dev.       Freq.
------------+------------------------------------
   doc<=25% |   635.85507   1658.9058          69
  doc(26-50 |   1306.5217   2563.7162          46
   doc>=51% |        3629    4149.536          10
------------+------------------------------------
      Total |    1122.112   2407.3049         125

                      Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups      80723954.4        2   40361977.2      7.72     0.0007
 Within groups       637870536      122   5228447.02
------------------------------------------------------------------------
    Total            718594490      124   5795116.86

Bartlett's test for equal variances:  chi2(2) =  22.1041  Prob>chi2 = 0.000
```

. oneway FarmImpExp degreeofcommercialization, tabulate

```
  RECODE of |        Summary of FarmImpExp
       DoC2 |        Mean   Std. Dev.       Freq.
------------+------------------------------------
   doc<=25% |   48.753623   77.385856          69
  doc(26-50 |    349.1087   1302.3552          46
   doc>=51% |        86.2   135.61203          10
------------+------------------------------------
      Total |      162.28   800.46029         125

                      Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups      2552798.33        2   1276399.17      2.03     0.1364
 Within groups      76898548.9      122   630315.974
------------------------------------------------------------------------
    Total           79451347.2      124   640736.671

Bartlett's test for equal variances:  chi2(2) = 296.9761  Prob>chi2 = 0.000
```

Annex E: Probit Estimates for Determinants of market Participation

```
. probit   mrktparticipation sex age  useirrigation   creditused laborforceME oxen
nonfarmparticipation  Literacy totalprodvalueinbirr totallandsize improvedseeduse
livestocksalesinbirr  tincomenonfarm tincomeofffarmemp


Probit regression                                 Number of obs   =        125
                                                  LR chi2(14)     =      90.06
                                                  Prob > chi2     =     0.0000
Log likelihood = -37.206646                       Pseudo R2       =     0.5476

------------------------------------------------------------------------------
mrktpartic~n |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         sex |   .2083539   .5048824     0.41   0.680    -.7811975    1.197905
         age |   .0021142   .0171813     0.12   0.902    -.0315605    .0357889
useirrigat~n |   1.318136   .6820596     1.93   0.053    -.0186763    2.654948
  creditused |   .1355022   .3983058     0.34   0.734    -.6451629    .9161672
laborforceME |   .0444402     .17301     0.26   0.797    -.2946531    .3835335
        oxen |   .0275592   .2236717     0.12   0.902    -.4108293    .4659478
nonfarmpar~n |  -.4854739    .651169    -0.75   0.456    -1.761742    .7907939
    Literacy |  -.6618196   .4198163    -1.58   0.115    -1.484644    .1610052
totalprodv~r |   .0003351   .0000952     3.52   0.000     .0001485    .0005217
totallands~e |   .2014662   .1125548     1.79   0.073    -.0191372    .4220696
improvedse~e |   .8196615   .3642965     2.25   0.024     .1056534     1.53367
livestocks~r |   .0000677   .0002553     0.27   0.791    -.0004327    .0005681
tincomenon~m |   .0001897    .000151     1.26   0.209    -.0001062    .0004856
tincomeoff~p |   .0002622   .0001662     1.58   0.115    -.0000636    .0005879
       _cons |  -3.647947   1.304025    -2.80   0.005    -6.203789   -1.092106
------------------------------------------------------------------------------

note: 0 failures and 9 successes completely determined.


. dprobit   mrktparticipation sex age  useirrigation   creditused laborforceME oxen
nonfarmparticipation  Literacy totalprodvalueinbirr totallandsize improvedseeduse
livestocksalesinbirr  tincomenonfarm tincomeofffarmemp


Probit regression, reporting marginal effects     Number of obs =    125
                                                  LR chi2(14)   =  90.06
                                                  Prob > chi2   = 0.0000
Log likelihood = -37.206646                       Pseudo R2     = 0.5476

------------------------------------------------------------------------------
mrktpa~n |      dF/dx   Std. Err.      z    P>|z|     x-bar  [    95% C.I.   ]
---------+--------------------------------------------------------------------
     sex*|   .0285082   .0656025     0.41   0.680      .216   -.10007  .157087
     age |   .0003143   .0025703     0.12   0.902    44.784  -.004723  .005352
useirr~n*|     .13861   .0686637     1.93   0.053      .272   .004032  .273188
cred~sed*|   .0208519   .0632913     0.34   0.734       .68  -.103197  .144901
laborf~E |   .0066057   .0259111     0.26   0.797    2.8096  -.044179   .05739
    oxen |   .0040965   .0332838     0.12   0.902     1.608  -.061139  .069332
nonfar~n*|  -.0545523    .060105    -0.75   0.456      .904  -.172356  .063251
Literacy*|   -.096164   .0700004    -1.58   0.115      .544  -.233362  .041034
totalp~r |   .0000498   .0000202     3.52   0.000   8778.84    .00001  .000089
totall~e |   .0299465   .0186604     1.79   0.073     5.438  -.006627   .06652
improv~e*|    .134442   .0790921     2.25   0.024      .568  -.020576   .28946
livest~r |   .0000101   .0000369     0.27   0.791   1004.44  -.000062  .000082
tincom~m |   .0000282   .0000245     1.26   0.209      1526   -.00002  .000076
tincom~p |    .000039   .0000295     1.58   0.115    885.36  -.000019  .000097
---------+--------------------------------------------------------------------
  obs. P |       .632
 pred. P |   .9200168  (at x-bar)
------------------------------------------------------------------------------
(*) dF/dx is for discrete change of dummy variable from 0 to 1
    z and P>|z| correspond to the test of the underlying coefficient being 0
```

Annex F: OLS Estimation results for Determinants of total value of crop sales

```
. reg  totalsalesinbirr sex age  educ totallandsize  totalFCprodvalueinbirr
totalCCprodvalueinbirr improvedseeduse useirrigation laborforceME oxen
memextpackage nonfarmparticipation livestocksalesinbirr usesfertilizer
transportaccess grossnonfarmincome, robust

Linear regression                                      Number of obs =      85
                                                       F( 16,    68) =   29.38
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.8674
                                                       Root MSE      =  1462.6

------------------------------------------------------------------------------
             |               Robust
totalsales~r |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         sex |   840.0623   390.8951     2.15   0.035     60.04333    1620.081
         age |   20.09615   18.07309     1.11   0.270    -15.96814    56.16044
        educ |   158.9815     100.28     1.59   0.118    -41.12412    359.0871
totallands~e |   34.75425    69.3937     0.50   0.618    -103.7187    173.2272
totalFCpro~r |   .2579017   .0582682     4.43   0.000     .1416292    .3741741
totalCCpro~r |   .7633203   .1010041     7.56   0.000     .5617698    .9648708
improvedse~e |   638.6931   323.7228     1.97   0.053     -7.28565    1284.672
useirrigat~n |   747.2285    437.084     1.71   0.092     -124.959    1619.416
laborforceME |   36.90518   204.6558     0.18   0.857    -371.4791    445.2894
        oxen |    451.266    170.917     2.64   0.010     110.2065    792.3255
memextpack~e |   424.6637   395.5026     1.07   0.287     364.5494    1213.877
nonfarmpar~n |  -130.5391   539.9188    -0.24   0.810     -1207.93     946.852
livestocks~r |  -.0716308   .0537464    -1.33   0.187      -.17888    .0356184
usesfertil~r |   1158.169   619.4804     1.87   0.066    -77.98535    2394.323
transporta~s |   525.5911   437.1829     1.20   0.233    -346.7939    1397.976
grossnonfa~e |  -.0286666   .0792653    -0.36   0.719     -.186838    .1295048
       _cons |  -4710.385   1743.163    -2.70   0.009    -8188.813   -1231.958
------------------------------------------------------------------------------
```

. vif

```
    Variable |       VIF       1/VIF
-------------+----------------------
totalFCpro~r |      2.26    0.442776
         age |      1.88    0.533062
totallands~e |      1.85    0.539262
        oxen |      1.77    0.565859
        educ |      1.71    0.583402
useirrigat~n |      1.66    0.602391
laborforceME |      1.65    0.604562
totalCCpro~r |      1.63    0.613572
transporta~s |      1.59    0.630770
grossnonfa~e |      1.53    0.653917
improvedse~e |      1.50    0.665157
nonfarmpar~n |      1.48    0.675824
         sex |      1.43    0.701002
memextpack~e |      1.40    0.713447
livestocks~r |      1.32    0.756941
usesfertil~r |      1.14    0.877830
-------------+----------------------
    Mean VIF |      1.61
```

```
. linktest
```

```
      Source |       SS       df       MS              Number of obs =      85
-------------+------------------------------           F(  2,    82) =  269.77
       Model |   952074459     2   476037230           Prob > F      =  0.0000
    Residual |   144699300    82  1764625.61           R-squared     =  0.8681
-------------+------------------------------           Adj R-squared =  0.8649
       Total |  1.0968e+09    84  13056830.5           Root MSE      =  1328.4

------------------------------------------------------------------------------
totalsales~r |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        _hat |   .9172599   .1328459     6.90   0.000     .6529871    1.181533
      _hatsq |   5.59e-06   8.50e-06     0.66   0.512    -.0000113    .0000225
       _cons |   173.2975   342.9927     0.51   0.615    -509.0243    855.6193
------------------------------------------------------------------------------
```

Annex G: Conversion of Labor force in to Man equivalent

Conversion of Household Labor force into man equivalent

The researcher used the following conversion factor to convert the labor force who took part in farming of a household in to its adult/man equivalent level. This conversion factor is directly adopted from Samuel and Sharp (2007).

Age Group	Male	Female
Less than 10	0.0	0.0
10 – 13	0.2	0.2
14 – 16	0.5	0.4
17 – 50	1	0.8
Above 50	0.7	0.5

Source: Samuel and Sharp (2007)